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DRAFT ENVIRONMENTAL ASSESSMENT

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR THE POTENTIAL UPGRADE OF THE TENASKA SITE FOR ESTABLISHING A SIMPLE-CYCLE OR COMBINED-CYCLE ELECTRIC GENERATION FACILITY

Haywood County, Tennessee

PREPARED BY:
TENNESSEE VALLEY AUTHORITY

JULY 2008

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THE PROPOSED DECISION AND NEED

This document is a supplement to the *Final Environmental Assessment for Potential Upgrade of the Tenaska Site for Establishing a Simple-Cycle or Combined-Cycle Electric Generation* Facility*, Haywood County, Tennessee* (Tennessee Valley Authority [TVA] 2007). The original environmental assessment (EA) assessed the impacts of purchasing the former Tenaska site and listed five potential operational scenarios. This site has been purchased and will now be called Lagoon Creek Combined Cycle (LCCC) facility. Of the five potential operational modes, TVA has selected a variation of Option 3 for additional environmental analysis.

The proposed action would be to install two M501F combustion turbines (CTs) and a General Electric steam turbine to build an approximately 600-megawatt (MW) combined-cycle (CC) plant. This existing generation site, which was permitted and constructed for three CTs, never operated due to the lack of transmission agreement for the facility. Subsequently, the CTs have been sold and removed from the site, and at this time, TVA has only been able to locate two CTs that can be utilized for this site. LCCC was also considered for the addition of a new simple-cycle (SC) generation capacity; however, this option will not be assessed as the economics and risks associated with delivery dates for the new turbines makes the option infeasible.

BACKGROUND

The purpose and need for this supplemental EA is fully detailed in the *Generic Environmental Assessment for the Purchase of Additional Combustion Turbine Capacity* (TVA 2006) and briefly below in this section. TVA tiered from this document to the *Final Environmental Assessment for Potential Upgrade of the Tenaska Site for Establishing a Simple-Cycle or Combined-Cycle Electric Generation Facility, Haywood County, Tennessee* (TVA 2007), for the purchase of the former Tenaska site along with five operational options. Initially, TVA analyzed the installation of CC capacity at the Lagoon Creek facility in *Final Environmental Impact Statement for Addition of Electric Generation Peaking and Base Load Capacity at Greenfield Sites, Haywood County, Tennessee* (TVA 2000).

The demand for total electrical power in the TVA power service area has been growing and continues to grow at a rate of about 600 MW (more than 2 percent) per year since the mid-1990s. Recent total peak demand for electricity in the TVA region has exceeded more than 32,000 MW.

Additionally, reliability standards recently submitted to the Federal Energy Regulatory Commission by the North American Electric Reliability Council (NERC) in compliance with the

Energy Policy Act of 2005 have required power companies to activate sufficient reserves to meet NERC's Disturbance Control Standard (DCS). Under this standard, recovery from loss of generation that is equal to or greater than 80 percent of the largest generator must be achieved within 15 minutes. NERC now requires firm capacity for DCS recovery events and no longer allows market purchases to be included as DCS recovery assets. As a result of the load growth and the recently filed NERC standards, TVA needs to procure up to 1,500 MW of peaking capacity and another 1,500 to 2,000 MW of intermediate capacity in the near term.

OTHER ENVIRONMENTAL REVIEWS AND DOCUMENTATION

Final Environmental Impact Statement for Addition of Electric Generation Peaking and Base Load Capacity at Greenfield Sites, Haywood County, Tennessee (TVA 2000)

Generic Environmental Assessment for the Purchase of Additional Combustion Turbine Capacity (TVA 2006)

Final Environmental Assessment for Potential Upgrade of the Tenaska Site for Establishing a Simple-Cycle or Combined-Cycle Electric Generation Facility, Haywood County, Tennessee (TVA 2007)

SCOPE OF THE ANALYSIS

The following resources have the potential to be affected by the proposed action.

- Groundwater
- Surface Water Quality
- Waste Water Quality
- Environmental Noise
- Air Quality
- Cultural Resources
- Socioeconomics
- Greenhouse Gases

Lagoon Creek Combined-Cycle Transmission Line Connection

TVA's proposed installation of an additional approximately 600 MW of generation at the recently acquired site adjacent to the existing Lagoon Creek Simple Cycle facility will require additional transmission infrastructure. All work for this project would take place on TVA property. TVA would construct a 0.5-mile 500-kilovolt (kV) transmission line from Lagoon Creek CT switchyard to the LCCC station (brownfield site). The new 500-kV transmission line (see Figure 1) would consist of four tower structures one that will be located outside of the fenced facility.

New circuit breakers, associated relay controls, and communication equipment would be installed in the existing switch houses and transformer yard. Other existing TVA facilities would require installation/replacement of telecommunication equipment in order to allow proper communication with the installation of the new breakers and transmission line at the Lagoon Creek site.

All spoil collected in the yard from trenching for cable/conduit runs and foundation work would be used as back fill in the trench or yard area and regraveled, or the spoil would be carried to a temporary storage area as depicted on Figure 1. Standard best management practices (BMPs) would be used to limit erosion and storm water runoff during the construction period.

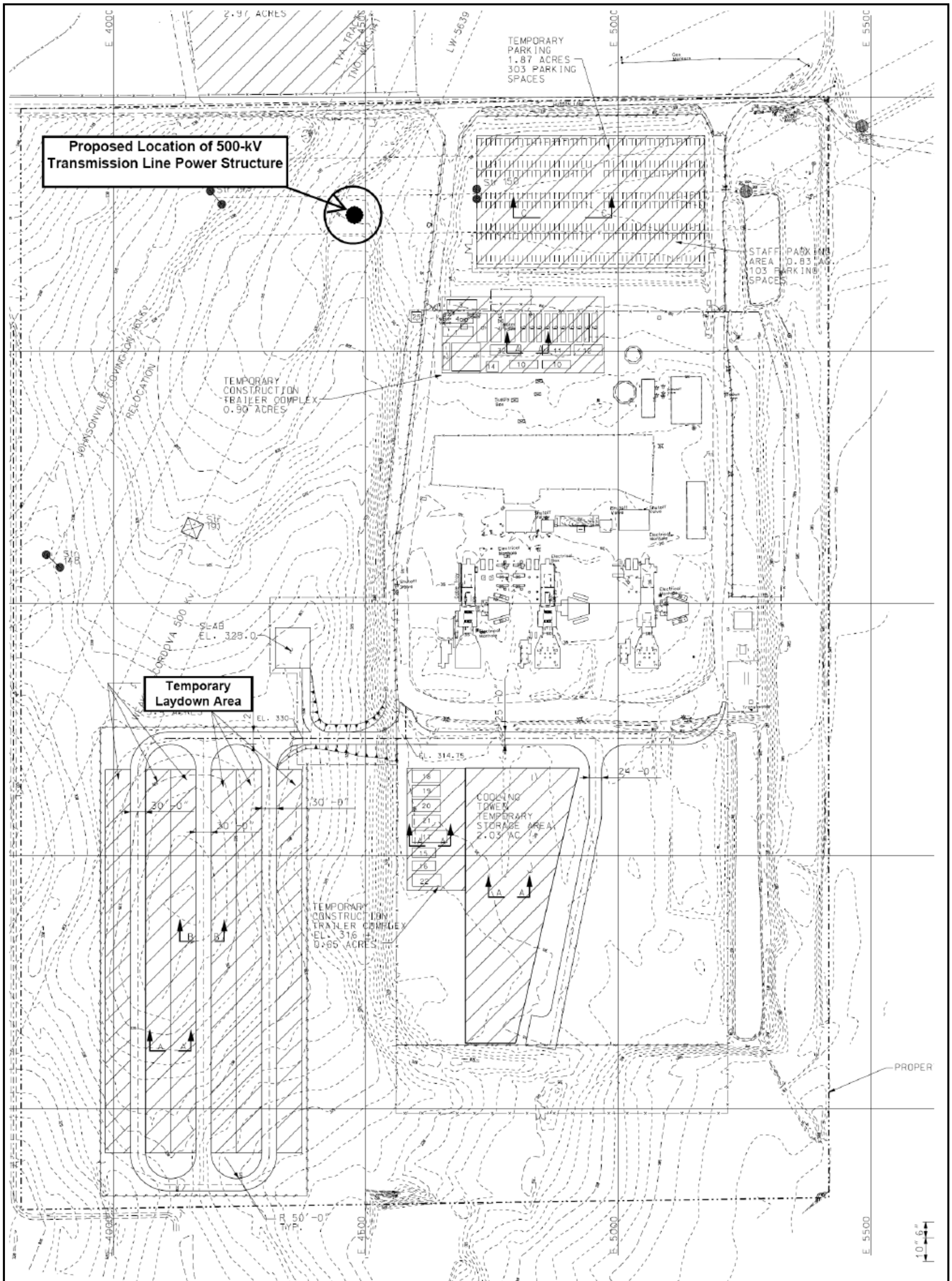


Figure 1. LCCC Site Map

ALTERNATIVES AND COMPARISON

With the benefit of iternal scoping TVA has determined that there are two alternatives available to TVA: the No Action Alternative and the completion of a CC plant at the Lagoon Creek site.

This supplemental EA assesses the impact of the purchase and operation of an existing site developed for use of CT/CC, as well as the No Action Alternative. The No Action Alternative does not meet TVA's need for additional peaking and intermediate capacity. If this facility had not been purchased, TVA would likely have to pursue greenfield construction at an increased cost and additional impact to the environment beyond reactivation of an existing vacated site with the existing infrastructure already in place.

TVA evaluated five options in the previously published *Final Environmental Assessment for Potential Upgrade of the Tenaska Site for Establishing a Simple-Cycle or Combined-Cycle Electric Generation Facility, Haywood County, Tennessee* for upgrading for simple- or combined-cycle operations with CTs at the Tenaska Brownsville site. The options range from adding 360 MW of simple-cycle capacity to approximately 900 MW of combined-cycle capacity. The five options are:

1. Purchase and installation of two Mitsubishi CTs in SC operation after modifying the "ultra-low," dry, low nitrogen oxides (NOx) combustion system to achieve less than 15 parts per million (ppm) NOx emissions. This option would have a total capacity of approximately 360 MW.

2. Purchase and installation of three CTs in SC operation with "ultra low" dry, low NOx combustion systems. This option would have a total of approximately 540 MW capacity.

3. Purchase and installation of two CTs and a 250-MW General Electric D11 CT that TVA has in storage for a 2x1 CC plant. This option would have a total capacity of approximately 600 MW.

4. Purchase and installation of three CTs and the 400-MW Toshiba steam turbine purchased from Calpine in a 3x1 CC operation. This option would have a total capacity of approximately 900 MW.

5. Option 3, plus a later installation of an additional CT (to be purchased) and a 140-MW steam turbine (to be purchased), in 1x1 CC operation. This option would have a total capacity of approximately 900 MW.

The different types of CTs that could be purchased for operation under the Action Alternative include SC single fuel, SC dual fuel, or CC dual fuel. All three types of CTs would likely have similar air impacts, assuming similarity in the fuel used. However, a CC would likely operate at higher noise levels and require more groundwater because of the use of cooling towers and the need for boiler make-up water. Similarly, CCs would have a slightly greater impact on water quality as a result of the discharge of heat.

The SC operations would require the addition of dry, low NOx combustion controls and would use much less water than the CC operations. CC operations would need to add selective catalytic reduction (SCR) for NOx control and potentially an oxidation catalyst to meet the New

Source Performance Standards. Combustion-cycle operations would likely require a prevention of significant deterioration (PSD) permit, since such operation would be for intermediate capacity involving higher annual hours of operation.

THE NO ACTION ALTERNATIVE

The No Action Alternative does not meet TVA needs for additional power to comply with the new NERC requirements.

ACTION ALTERNATIVE – NEW CC CAPACITY

This alternative includes the potential installation of two M501F CTs and a General Electric steam turbine to build and operate an approximately 600-MW CC plant at the Lagoon Creek site.

AFFECTED ENVIRONMENT AND EVALUATION OF IMPACTS

GROUNDWATER RESOURCES

Affected Environment

The principal aquifers in the project site region include, in descending order from the ground surface: the Cockfield formation, the Memphis Sand, and the Fort Pillow Sand formation (see Attachment 1 for an explanation of aquifer characteristics). The Cockfield formation is the principal source of water in the region for domestic and farm water supplies. It consists of interbedded sand, silt, clay, and lignite of fluvial origin. The thicker and more productive sand beds are commonly found near the base of the formation. The Cockfield formation is absent in the eastern half of Haywood County, but the formation thickness exceeds 200 feet in the extreme northwestern corner of the county. Thick clay beds of the Cook Mountain formation lie beneath the Cockfield aquifer and retard the downward movement of groundwater to the underlying Memphis Sand aquifer. Wells in the Cockfield aquifer rarely exceed 350 feet in depth, and most are less than 200 feet. The aquifer supports small to moderate capacity wells having yields of 5 to 300 gallons per minute (gpm) (Parks 1985).

The Memphis Sand aquifer is a major source of public and industrial water in western Tennessee. It is the source of water for all of the municipalities surrounding the proposed plant sites including Brownsville, Ripley, Covington, and Stanton. The aquifer is very productive, yielding up to 2,300 gpm to individual wells in western Tennessee. The Memphis Sand primarily consists of massive beds of fine to coarse sand with relatively few interbedded silt and clay layers. The formation ranges up to 900 feet in thickness in down-dip areas in the western part of the region and is thinnest along the eastern outcrop area (see Figure 3-4 of the Lagoon Creek environmental impact statement [TVA 2000]). Formation thickness in Haywood County ranges from approximately 200 feet in the southeastern corner of the county to 600 feet in the northwestern corner. The base of the Memphis Sand dips westward at rates of 20 to 50 feet per mile. The Flour Island formation is the lower confining unit for the Memphis Sand aquifer, separating it from the underlying Fort Pillow aquifer.

The Fort Pillow formation is present throughout Haywood County and most of western Tennessee. It is a potentially important aquifer in the region but currently is not widely used because of the availability of shallower groundwater in most areas. Present use is limited to areas in and near the formation outcrop in Carroll, Hardeman, Henry, and Madison counties and to the Memphis area in Shelby County. The Fort Pillow is primarily composed of fine to medium sand with relatively minor amounts of interbedded silt and clay. Formation thickness generally increases from east to west across western Tennessee, with thickness ranging from about 100 feet in southeastern Haywood County to about 300 feet in the northwestern part of the county. The base of the formation dips westward at rates of 25 to 50 feet per mile (Parks and Carmichael 1989). The Fort Pillow aquifer is underlain, in turn, by the Old Breastworks, Port Creek, and Clayton formations, all of which are confining units. These confining units separate the Fort Pillow aquifer from the deeper McNairy-Nacatoch aquifer.

TVA pump test data from test hole #1, located at the neighboring Lagoon Creek generation facility, indicate that individual well pumping rates of 1,000 gpm are probably achievable in the Memphis Sand aquifer, and individual well pumping rates of 500 gpm are probably achievable in the Fort Pillow Sand aquifer.

A 1999 survey of water supply wells in the site vicinity indicated groundwater development in the site region is primarily limited to the Cockfield and Memphis Sand aquifers. The Memphis Sand aquifer is the source of water for all public and industrial supplies within 10 miles of the site, including the Brownsville and Ripley municipal supplies. Brownsville operates seven wells in and around the city and two wells located in the Tibbs Community some 9 to 10 miles northwest of the city. Total groundwater withdrawals by Brownsville in 1998 were reported to be 2.0 millions of gallons per day (MGD). The historical groundwater use for Brownsville and other surrounding municipalities presented in Table 3-7 of the Lagoon Creek environmental impact statement (TVA 2000) indicates regional growth in groundwater withdrawals from the Memphis aquifer of approximately 3 percent per year since 1953. The Cockfield formation is the principal source of supply for shallow residential and farm wells in the region. Of the 26 registered wells within a 2-mile radius of the Lagoon Creek facility, 84 percent are completed in the Cockfield formation and 16 percent in the Memphis Sand. An additional 36 residences within the survey region in areas not served by public water are presumed to have wells.

Environmental Consequences

The original project EA considered five CT plant design options (TVA 2007). However, subsequent evaluations by TVA indicate the proposed LCCC site is best suited for a CC CT plant. TVA committed in the original EA to further evaluate plant groundwater use impacts if a decision were made to install a CC CT facility at the proposed LCCC site. In accordance with that commitment, this section of the supplemental EA addresses the environmental consequences of groundwater use for plant operations over the projected 30-year life of the proposed CC CT plant, focusing on groundwater potentiometric declines in Memphis Sand aquifer—the proposed source of water for plant operations—and in adjacent aquifers. The evaluation also considers cumulative impacts of long-term groundwater withdrawals associated with (1) the proposed LCCC plant, (2) four other proposed TVA CC CT plants in the western part of the TVA power service area, and (3) regional public and large self-supplied industrial groundwater supplies.

NO ACTION ALTERNATIVE

There would be no potential adverse impacts to groundwater resources of this alternative beyond that which would occur as a result of current and future regional groundwater use. An estimate of the magnitude of groundwater level declines (i.e., drawdown) that might occur in the site locality over a 30-year period due to regional groundwater withdrawals by public and large industrial users (other than TVA) is included in the following section.

COMBINED-CYCLE COMBUSTION TURBINE PLANT ALTERNATIVE

Construction Impacts

Refer to previous project EA (TVA 2007) for a discussion of potential construction impacts to groundwater resources.

Operational Impacts

Operational water requirements for the proposed LCCC plant and four other potential TVA CT plants in the region are summarized in Table 1. Conservative estimates of long-term average water demand and short-term peak water requirements are provided for each plant. Average water demands assumed a conservatively high plant capacity factor of 60 percent. Peak water demands were estimated for an assumed 30-day period of worst-case summer meteorological conditions. The proposed well field for the proposed LCCC plant would consist of four-five production wells completed in the Memphis aquifer, each capable of producing 1,000 gpm and all located within the LCCC property boundary. Well-field operation over the assumed 30-year life of the facility would be expected to reduce groundwater potentiometric levels in the Memphis aquifer and, to a lesser extent, aquifers that lie above and below the Memphis aquifer.

Table 1. Estimated Water Requirements of Proposed TVA Combined-Cycle Combustion Turbine Plants

Plant	Source Aquifer	Number of Wells	Annual Average Water Demand (gpm)	30-day Maximum Water Demand (gpm)
LCCC	Memphis	4	1,643	2,315
Gleason	Memphis	unknown	2,460	3,473
Jackson	Memphis	unknown	2,460	3,473
Magnolia	Upper Wilcox	12	2,460	3,473
	Lower Wilcox	3		
Southaven	Lower Wilcox	6	2,460	3,473

Potential impacts of plant groundwater withdrawals were evaluated by the U.S. Geological Survey (Nashville office) using the groundwater flow model developed for the Mississippi Embayment Regional Aquifer Study (MERAS) (Haugh 2008). The numerical modeling code used for the MERAS model is MODFLOW-2005 (Harbaugh 2005). The MERAS model is a large-scale regional groundwater flow model encompassing some 97,000 square miles of the northern Mississippi embayment. The grid cell size of the MERAS model is generally 1.0 square mile except in the vicinity of the LCCC site where refined grid intervals of 0.2 mile were applied. The model consists of 13 layers corresponding to aquifers and confining units from land surface down to the top of the Midway Group. In Tennessee, this includes the following aquifers: the alluvial-fluvial deposits aquifer, the Cockfield aquifer, the Memphis aquifer, and the Fort Pillow aquifer (stratigraphically equivalent to Upper and Lower Wilcox aquifers in Mississippi). The model has been extensively calibrated using groundwater use information dating back to 1870 and incorporates the most current water use data available. Further information regarding the MERAS model can be found at the MERAS Web site (http://ar.water.usgs.gov/meras/index2.php).

Two long-term (30 years plus 30 days) groundwater use scenarios were simulated: (1) groundwater withdrawals associated only with LCCC plant operations and (2) concurrent groundwater withdrawals by all proposed TVA CC CT plants and other regional public and industrial users for assessment of cumulative drawdown effects. Projections of groundwater pumping rates by public and industrial users were estimated assuming linear growth in demand of 2 percent per year. Impacts were evaluated by comparing the difference in predicted water level declines in the aquifers at each of the sites at the end of simulations for each of the two scenarios described above.

Results

The predicted final drawdown distribution in the Memphis aquifer resulting from proposed LCCC plant well field operations is shown on Figure 2. Existing public and private water supply wells in the plant vicinity are presented on the figure to allow evaluation of drawdown effects on neighboring groundwater users. Data on existing water supply wells were obtained from Tennessee Department of Environment and Conservation (TDEC) records of registered wells (Scott Marshall, TDEC, personal communication, June 16, 2008) and from a drive-by well inventory conducted in 1999 (TVA 2000).

The overall magnitude of drawdown predicted in the Memphis aquifer is small but widespread, extending over a large portion of northwestern Haywood County. Drawdown ranges from about 10 feet at the plant boundary to less than 2 feet at Brownsville, some 8 miles southeast of the plant. Maximum water level declines estimated for existing Memphis aquifer wells located closest to the plant would be approximately 6 feet. Drawdowns of this magnitude would result in minor increases in pumping lifts and associated costs but would not be expected to impair well performance. Predicted drawdown in the overlying Cockfield aquifer in the plant locality was 2.1 feet or less, indicating the Cook Mountain formation (confining unit) effectively separates the Cockfield and Memphis aquifers. Similarly, the Flour Island formation (confining unit) separating the Memphis aquifer from the underlying Fort Pillow aquifer limited the maximum drawdown in the Fort Pillow to 1.6 feet. Therefore, existing wells completed in either the Cockfield or Fort Pillow aquifers would not be adversely impacted by proposed plant groundwater withdrawals from the Memphis aquifer.

The cumulative drawdowns predicted in the Memphis aquifer at the end of the simulation period due to groundwater withdrawals by all major public and industrial users in the region (including TVA CT plants) are presented in Figures 3 and 4. Extensive groundwater withdrawals in Shelby County, Tennessee, account for much of the cumulative drawdown predicted in the Memphis aquifer in the site region, despite the distance separating the plant from Shelby County (Figure 3). For example, total groundwater pumpage reported in Shelby County in 2000 averaged 188 MGD, accounting for approximately 72 percent of total groundwater usage in western Tennessee (Webbers 2003). Other major pumping centers in closer proximity to the plant site include public groundwater systems operated by Brownsville, Dyersburg, Ripley, Covington, and Trenton.

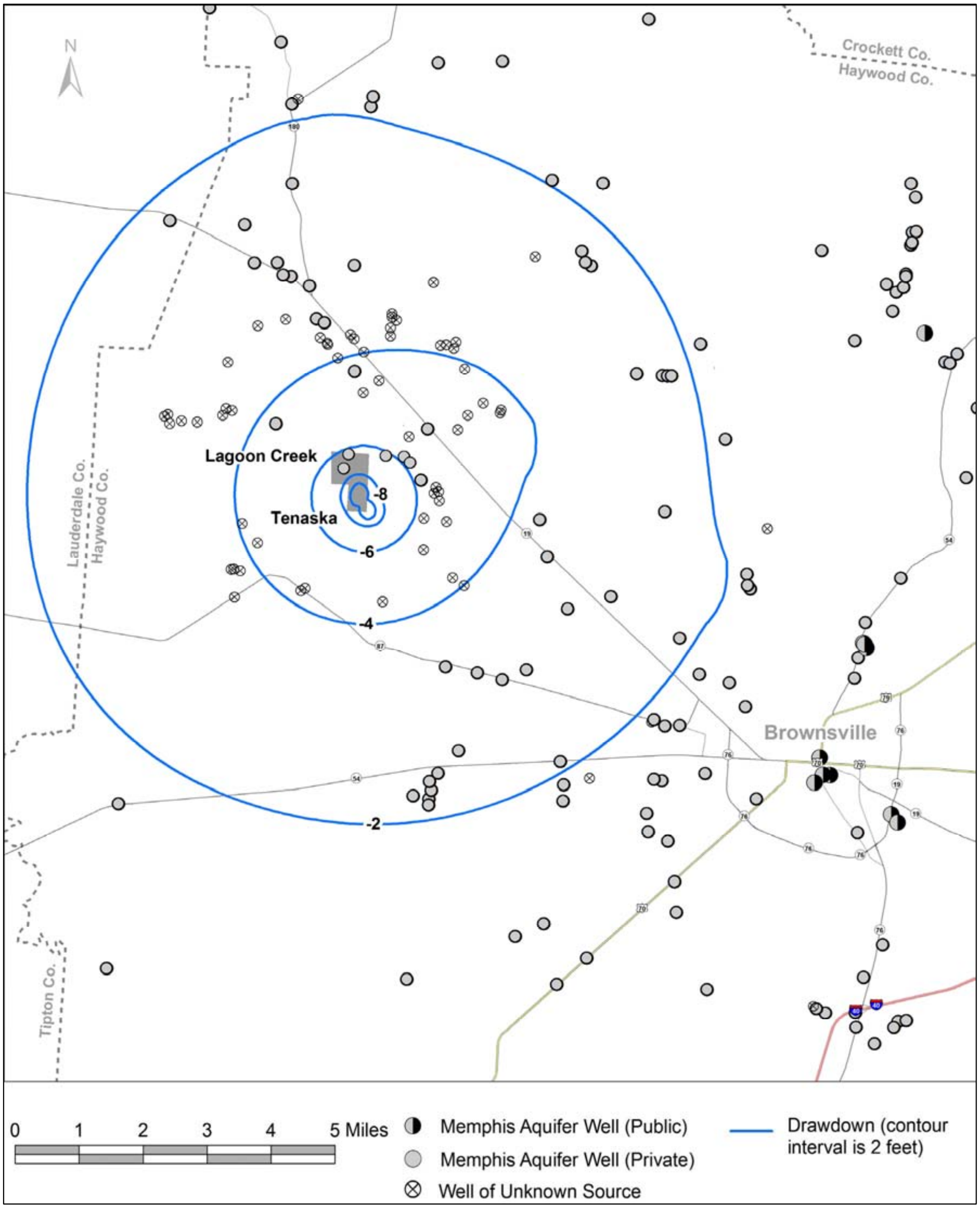


Figure 2. Predicted Drawdown in Memphis Aquifer in Site Locality Due to Groundwater Withdrawals From LCCC Plant

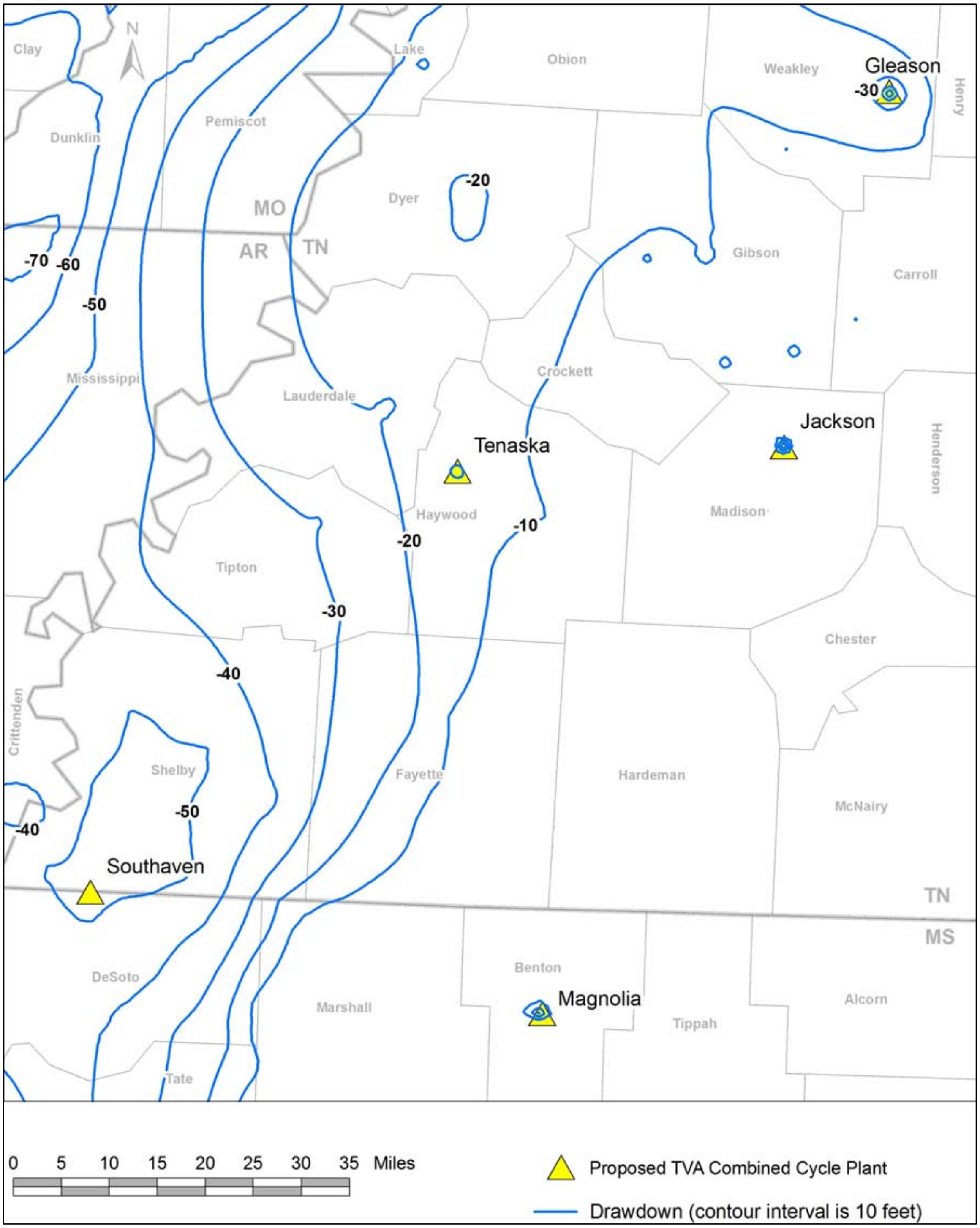


Figure 3. Predicted Cumulative Drawdown in Memphis Aquifer in Site Region Due to All Groundwater Withdrawals

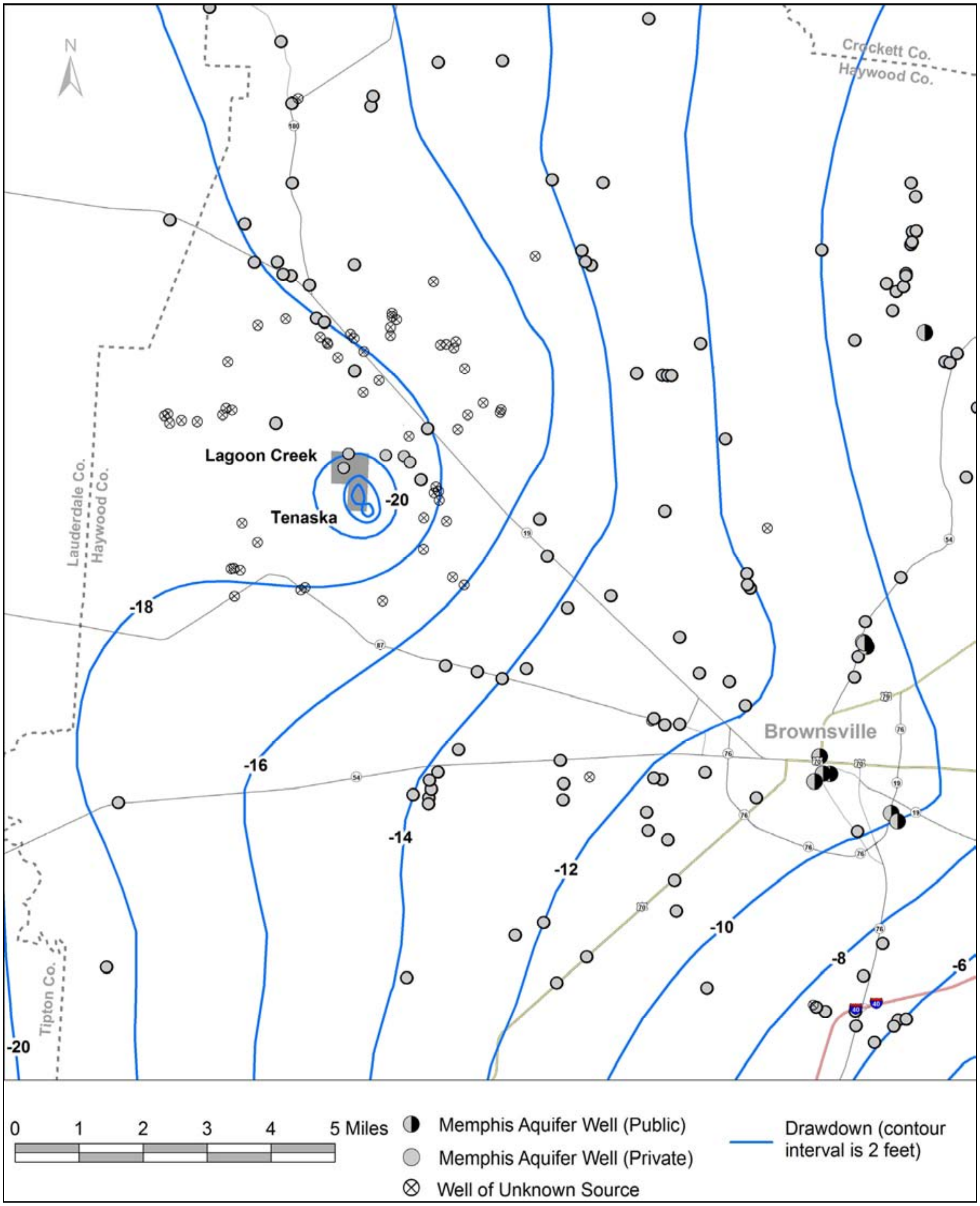


Figure 4. Predicted Cumulative Drawdown in Memphis Aquifer in Site Locality Due to All Groundwater Withdrawals

Cumulative drawdown predicted in the plant locality (Figure 4) is substantially greater than that produced by LCCC plant groundwater use alone (Figure 2). Cumulative drawdowns range from approximately 24 feet at the plant boundary to about 11 feet at Brownsville. Regional groundwater withdrawals by all non-TVA users account for about 10 to 14 feet of drawdown in the plant locality. Moderate drawdowns of less than 20 feet would be expected in the Memphis aquifer wells located closest to the LCCC plant. Drawdowns of this magnitude would result in minor increases in pumping lifts and associated costs but would not be expected to impair well performance. Predicted cumulative drawdowns of approximately 10 feet or less were predicted in both Cockfield and Fort Pillow aquifers, which again would not be expected to impair performance of existing wells completed in these aquifers.

SURFACE WATER

Affected Environment

The Lagoon Creek site is drained by a channelized unnamed tributary of Lagoon Creek, which appears as an intermittent flow stream on the Durhamville, Tennessee, Quadrangle map. Field observations confirmed that the unnamed wet-weather conveyance appears to be a typical farm drainage ditch. Lagoon Creek (HUC [hydrologic unit code] TN08010208-033-1000), a tributary of the Hatchie River, has the following designated uses: fish and aquatic life, recreation, irrigation, livestock watering, and wildlife (TDEC 1997). Lagoon Creek has been listed as impaired because of organic enrichment/oxygen depletion and habitat alteration (TDEC 2006). The sources of impairment are undetermined.

The Hatchie River watershed (HUC 08010208, shown in Figure 5) is located primarily in western Tennessee, with a small portion in northern Mississippi, and lies within the Level III Southeastern Plains (65), Mississippi Alluvial Plain (73), and Mississippi Valley Loess Plains (74) ecoregions (USEPA 1997). The Hatchie River watershed, located in Chester, Fayette, Hardeman, Haywood, Lauderdale, Madison, and Tipton counties, Tennessee, and Benton and Tippah counties, Mississippi, has a drainage area of approximately 1,461.6 square miles. Predominant land use in the Hatchie River watershed is agriculture (49.4 percent), followed closely by forest (48.4 percent). Urban areas represent approximately 1.0 percent of the total drainage area of the watershed.

Because of low flows (less than or equal to 3Q20 flow) in the Hatchie River during the summer and early fall, the source water for the proposed facility would be groundwater from wells. Table 2 lists available data about constituents in the local groundwater. Additional details are provided in the section on groundwater.

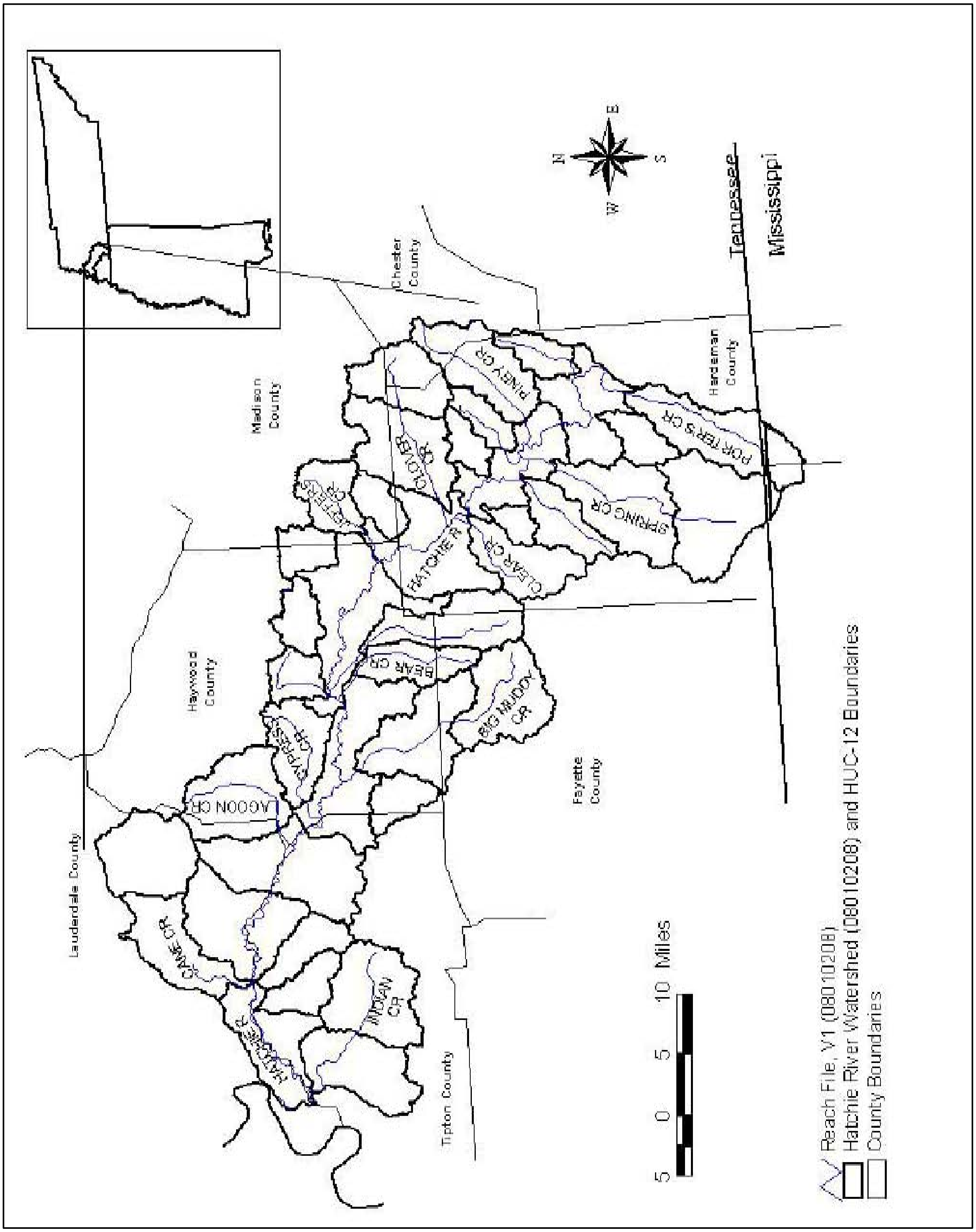


Figure 5. Hatchie River Watershed (HUC 08010208)

Table 2. Water Quality Data for Local Aquifers

Parameter	Units	Memphis Sand	Fort Pillow	Well L-1	USEPA, MCL
Acidity, total as CaCO3	mg/L	20	25	<10	
Alkalinity, total as CaCO3	mg/L	47	48	33	
Aluminum, dissolved	µg/L	< 50.	< 50.	<100	200(s)
Aluminum, total	µg/L	< 50.	< 50.	<100	200(s)
Ammonia nitrogen	mg/L	<0.01	0.2	<0.1	
Antimony, dissolved	µg/L	< 1.	< 1.	<1	6
Apparent color	PC Units	15	10		
Arsenic, dissolved	µg/L	< 1.	< 1.	<1	50
Barium, dissolved	µg/L	20	110	17	2000
Beryllium, dissolved	µg/L	< 1.	< 1.	<2	4
Bicarbonate (calculated)	mg/L	45	45		
Ca/Mg hardness as CaCO3 (calc.)	mg/L	39	14	27	
Cadmium, dissolved	µg/L	< 0.1	< 0.1	<0.5	5
Calcium, dissolved	mg/L	10	3.1	11	
Calcium, total	mg/L	10	3.1	11	
Carbon dioxide, dissolved (field)	mg/L	37	42		
Chloride	mg/L	1	1	1.3	250
Chromium, dissolved	µg/L	< 1.	< 1.	<1	100
Copper, dissolved	µg/L	< 10.	< 10.	<1	1300
Copper, total	µg/L	20	10	43	1300
Cyanide, total	mg/L	< 0.01	(no data)		
Fluoride	mg/L	< 0.1	< 0.1	<0.1	4
Hydrogen sulfide, dissolved (field)	mg/L	0	0		
Iron, dissolved	µg/L	460	3700	560	300(s)
Iron, total	µg/L	470	4900	590	300(s)
Kjeldahl nitrogen, total	mg/L	0.09	0.22	<0.5	
Lead, dissolved	µg/L	< 1.	< 1.	<1	50
Magnesium, dissolved	mg/L	3.5	1.4	3.9	
Magnesium, total	mg/L	3.5	1.4	3.8	
Manganese, dissolved	µg/L	< 5.	120	<10	50(s)
Manganese, total	µg/L	< 5.	120	<10	50(s)
Mercury, dissolved	µg/L	< 0.2	< 0.2	<0.2	2
Nickel, dissolved	µg/L	6	2	<1	100
Nitrate-nitrite nitrogen	mg/L	0.08	< 0.01	<0.1	11
Nitrate nitrogen	mg/L	0.05	<0.01	<0.1	
Nitrite nitrogen	mg/L	0.03	< 0.01	<0.1	
pH (field)	s.u.	6.3	6.3		6.5-8.5
Phosphorus, total	mg/L	< 0.01	0.17	<0.1	
Potassium, total	mg/L	0.5	3.2	0.71	
Selenium, dissolved	µg/L	< 1.	< 1.	1.5	50
Silicon, total	µg/L	4700	9700	3500	
Silver, dissolved	µg/L	< 10.	< 10.	<0.5	100
Sodium, total	mg/L	4.6	14	4.6	
Sulfate	mg/L	5	8	<5	250
Sulfide, total	mg/L	< 0.02	< 0.02	<0.05	
Thallium, dissolved	µg/L	< 1.	< 1.	<1	2
Total dissolved solids	mg/L	50	70	62	500

Parameter	Units	Memphis Sand	Fort Pillow	Well L-1	USEPA, MCL
Total inorganic carbon	mg/L	23	27	26	
Total organic carbon	mg/L	0.5	0.2	<1	
Total suspended solids	mg/L	< 1.	5	<1	
True color	PC Units	15	10	17	
Turbidity	NTU	1	3	0.48	
Zinc, dissolved	µg/L	20	20	<10	5000
Zinc, total	µg/L	20	10	<10	5000

WASTEWATER

A. Construction

Storm Water

The maximum area to be disturbed by construction would be approximately 80 acres. Site runoff would be managed in accordance with storm water BMPs to mitigate any erosion and would result in minimal impacts. A National Pollutant Discharge Elimination System (NPDES) construction storm water permit will be obtained prior to any disturbance.

Sanitary Wastewater

During the construction phase, sanitary sewage would be collected in temporary toilet facilities and trucked to a suitable and permitted sewage disposal facility (such as the Brownsville Wastewater Treatment Plant) for disposal.

B. Operation

Storm Water

After construction, storm water BMPs would continue to be implemented so that surface water runoff from parking lot and industrially used areas of the site would be diverted to a retention pond(s) with a controlled rate(s) of release. As shown in Figure 6, runoff from areas with potential oil leaks would be directed to an oil/water separator with subsequent discharge to the retention pond(s). Oil collected in the oil/water separator would be periodically removed and trucked off site to an approved, waste oil recycling facility.

Sanitary Wastewater

During plant operations, there would be a small workforce of up to 30 people at the site. Sanitary sewage would be collected in a septic tank and discharged to a drain field constructed on site.

Process Wastewater

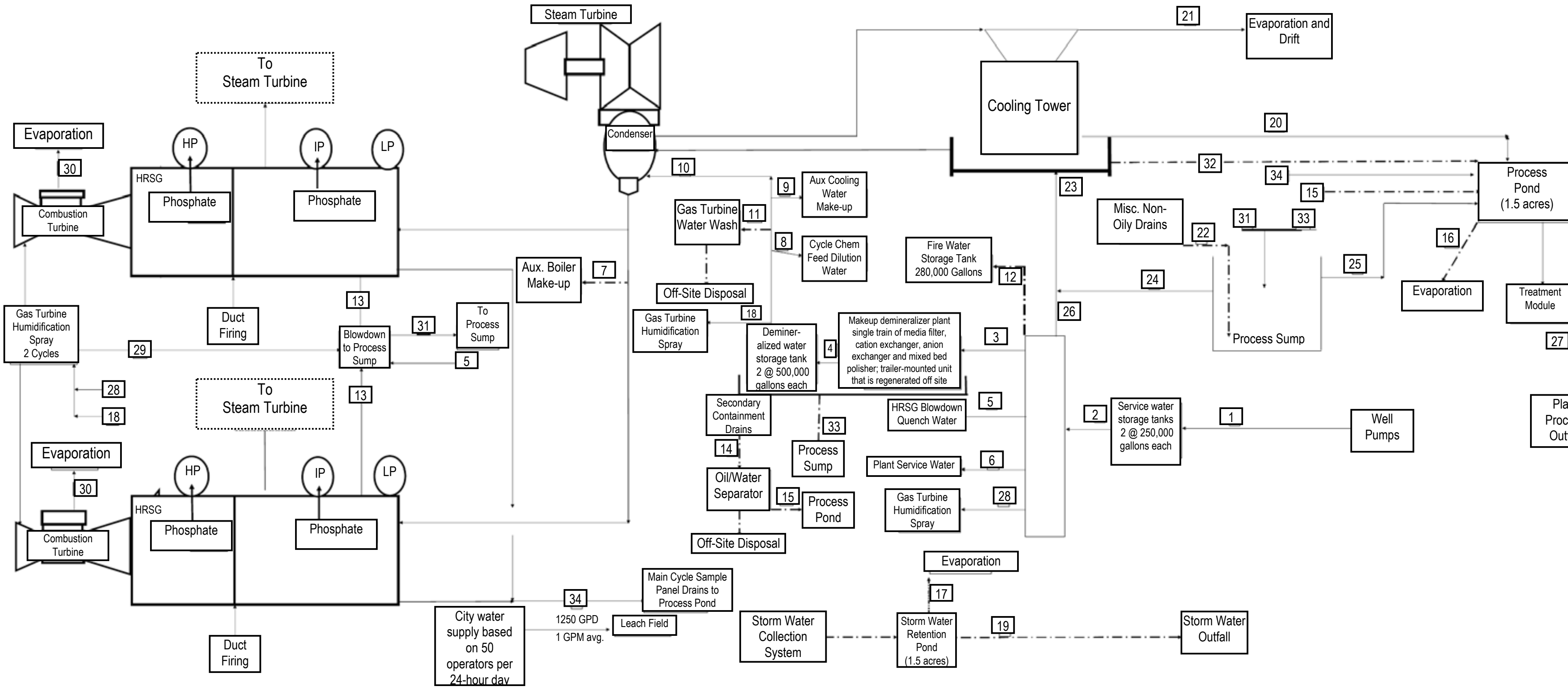
The proposed operation of CTs in the CC mode (i.e., with heat recovery) for base load generation, would require an NPDES wastewater discharge permit.

The proposed facility would include a heat recovery steam generator (HRSG). The HRSG would require a continuous demineralized water feed to replace boiler blowdown. In addition, cooling towers would be used to cool the steam cycle’s condenser water. Cooling towers produce continuous blowdown to remove excess minerals.

03/21/08

TVA LAGOON CREEK LLC
URS Corporation
Washington Division

Preliminary Water Balance
108F Case 4A Revision 4



Notes:
1. Water balance for Heat Balance Case 4A, T = 108ºF; 100% power; Evap cooling "On"; Two (2) turbines operating; Duct firing "On"; Evap cooler "On"
2. Blowdown flow set at 3% MSR.
3. Misc boiler losses set at "Zero" (0).
4. Flows are based on a 24-hour values, not instantaneous flow rate.
5. Flows have been rounded off to the nearest unit.
6. Evaporative cooler fed by 50/50 blend of well and demineralized water.
7. Intermittent flows are indicated by dashed lines.

Figure 6. Preliminary Water Balance, Case 4A-108F

Several cases were evaluated to estimate the probable range of water requirements for the LCCC plant. To be conservative, all cases were evaluated at 100 percent power and six cycles of cooling tower operation. The needed well water flows ranged from 1,509 to 3,750 gpm. At plant capacity factors of 40 or 60 percent, the needed flows would still be high for short periods but would drop significantly on a monthly and annual basis.

As an example, the water balance schematic for Case 4A-108F is shown in Figure 6, and the respective flows are listed in Table 4. The cooling tower blowdown would be the primary flow through the process wastewater pond in all these cases. During the dry months of the summer, the flow in Lagoon Creek would probably be zero, so this discharge would become the stream flow during these periods. This could create a small perennial stream from the current wet-weather conveyance.

Table 3. Estimated LCCC Plant Water Requirements

Case Number	Air Temperature (ºF)	Evap Cooler	Flow (gpm)
4A	108	On	3,750
3A	95	On	3,230
1	59	Off	2,268
2A	20	Off	1,509

Compressor wash water would be collected and disposed off site at an approved wastewater treatment facility.

Process wastewater and cooling tower blowdown would be treated and discharged to the unnamed tributary of Lagoon Creek as shown in Table 5. The primary constituents of the cooling tower blowdown would be those parameters present in the source groundwater concentrated six times. The estimated blowdown concentrations are listed in Table 5. Parameters where there is a possibility of exceeding USEPA’s maximum contaminant level (MCL) or Tennessee’s Water Quality Standard are highlighted in yellow. These are conservative estimates based in most cases on multiplying one-half of the minimum detection limit by the concentration factor of 6. Table 6 contains an alternative list of estimated blowdown chemistry provided by the cooling tower design firm.

Table 4. Case 4A: Temperature = 108ºF; 100 Percent Power; Evap Cooler-On; 2 Turbine Op; Fired; Vlv Design; Tower Cycles = 6

STREAM	1	2	3	4	5	6	7	8	9
Flow Lbs/Hr	1.88E+06	1.88E+06	6.29E+04	6.29E+04	3.25E+04	2.50E+03	0.00E+00	0.00E+00	0.00E+00
Flow GPM	3,760.20	3,760.20	125.80	125.80	65.00	5.00	0.00	1.00	1.00
Flow GPD	5.41E+06	5.41E+06	1.81E+05	1.81E+05	9.36E+04	7.20E+03	0.00E+00	1.44E+03	1.44E+03
Description	Well Water	Service Water	Feed To Makeup	Makeup to Demin Tk	HRSG Quench	Plant Serv. Water	Aux Boiler Makeup	Chem Feed Dilution	Aux Cooling Makeup

STREAM	10	11	12	13	14	15	16	17	18
Flow Lbs/Hr	0.00E+00	0.00E+00	1.33E+06	2.00E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Flow GPM	84.80	0.00	2,660.00	39.90	0.00	0.00	0.50	0.00	39.00
Flow GPD	1.22E+05	0.00E+00	3.83E+06	5.75E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Description	Cycle Makeup	GT Water Wash	Condensate To HRSG	HRSG(2) Blowdown	Oily Waste Water	Oil Free Water	Process Pond Evaporation	Storm water Pond Evaporation	Demin GT Humid Spray

STREAM	19	20	21	22	23	24	25	26	27
Flow Lbs/Hr	0.00E+00	3.09E+05	1.55E+06	2.50E+03	1.85E+06	9.19E+04	-1.70E+04	1.76E+06	2.92E+05
Flow GPM	0.00	618.20	3,091.00	5.00	3,709.20	183.80	-34.00	3,525.40	584.20
Flow GPD	0.00E+00	8.90E+05	4.45E+06	7.20E+03	5.34E+06	2.65E+05	-4.90E+04	5.08E+06	8.41E+05
Description	Storm Water	CT Blowdown	CT Evap. & Drift	Misc. Non Oily Drains	CT Makeup	Reclaim CT Mup	Waste To Blowdown	Service Water To CT	Waste To Outfall

STREAM	28	29	30	31	32	33
Flow Lbs/Hr	1.95E+04	1.95E+04	9.75E+03	9.19E+04	0.00E+00	0.00E+00
Flow GPM	39.00	39.00	19.50	183.80	0.00	0.00
Flow GPD	5.62E+04	5.62E+04	2.81E+04	2.65E+05	0.00E+00	0.00E+00
Description	Service Water GT Humid	Blowdown GT Humid	GT Humid. Evaporation	To Process Sump	CT Basin Drain	MUD &Tk Drain

Table 5. Blowdown Estimates - Groundwater Concentrations x 6

Parameter	Units	Memphis Sand	Memphis Sand x6	Fort Pillow	Fort Pillow x6	Well L-1	L-1 x6	USEPA, MCL	Tenn. Gen. WQ
Acidity, total as CaCO3	mg/L	20	120	25	150	<10	30		
Alkalinity, total as CaCO3	mg/L	47	282	48	288	33	198		
Aluminum, dissolved	µg/L	< 50.	150	< 50.	150	<100	300	200(s)	
Aluminum, total	µg/L	< 50.	150	< 50.	150	<100	300	200(s)	
Ammonia nitrogen	mg/L	<0.01	0.03	0.2	1.2	<0.1	0.3		
Antimony, dissolved	µg/L	< 1.	3	< 1.	3	<1	3	6	5.6
Apparent color	PC Units	15	90	10	60				
Arsenic, dissolved	µg/L	< 1.	3	< 1.	3	<1	3	50	10
Barium, dissolved	µg/L	20	120	110	660	17	102	2000	
Beryllium, dissolved	µg/L	< 1.	3	< 1.	3	<2	6	4	
Bicarbonate (calculated)	mg/L	45	270	45	270				
Ca/Mg hardness as CaCO3 (calc.)	mg/L	39	234	14	84	27	162		
Cadmium, dissolved	µg/L	< 0.1	0.3	< 0.1	0.3	<0.5	1.5	5	0.25
Calcium, dissolved	mg/L	10	60	3.1	18.6	11	66		
Calcium, total	mg/L	10	60	3.1	18.6	11	66		
Carbon dioxide, dissolved (field)	mg/L	37	222	42	252				
Chloride	mg/L	1	6	1	6	1.3	7.8	250	
Chromium, dissolved	µg/L	< 1.	3	< 1.	3	<1	3	100	100
Copper, dissolved	µg/L	< 10.	30	< 10.	30	<1	3	1300	9
Copper, total	µg/L	20	120	10	60	43	258	1300	
Cyanide, total	mg/L	< 0.01	0.03	(no data)					5.2
Fluoride	mg/L	< 0.1	0.3	< 0.1	0.3	<0.1	0.3	4	
Hydrogen sulfide, dissolved (field)	mg/L	0	0	0	0				
Iron, dissolved	µg/L	460	2760	3700	22200	560	3360	300(s)	
Iron, total	µg/L	470	2820	4900	29400	590	3540	300(s)	
Kjeldahl nitrogen, total	mg/L	0.09	0.54	0.22	1.32	<0.5	1.5		
Lead, dissolved	µg/L	< 1.	3	< 1.	3	<1	3	50	2.5
Magnesium, dissolved	mg/L	3.5	21	1.4	8.4	3.9	23		
Magnesium, total	mg/L	3.5	21	1.4	8.4	3.8	23		
Manganese, dissolved	µg/L	< 5.	15	120	720	<10	30	50(s)	
Manganese, total	µg/L	< 5.	15	120	720	<10	30	50(s)	
Mercury, dissolved	µg/L	< 0.2	0.6	< 0.2	0.6	<0.2	0.6	2	0.05
Nickel, dissolved	µg/L	6	36	2	12	<1	3	100	52
Nitrate-nitrite nitrogen	mg/L	0.08	0.48	<0.01	0.03	<0.1	0.3	11	
Nitrate nitrogen	mg/L	0.05	0.3	<0.01	0.03	<0.1	0.3		

Parameter	Units	Memphis Sand	Memphis Sand x6	Fort Pillow	Fort Pillow x6	Well L-1	L-1 x6	USEPA, MCL	Tenn. Gen. WQ
Nitrite nitrogen	mg/L	0.03	0.18	<0.01	0.03	<0.1	0.3		
pH (field)	s.u.	6.3	37.8	6.3	37.8			6.5-8.5	
Phosphorus, total	mg/L	< 0.01	0.03	0.17	1.02	<0.1	0.3		
Potassium, total	mg/L	0.5	3	3.2	19.2	0.71	4.3		
Selenium, dissolved	µg/L	< 1.	3	< 1.	3	1.5	9	50	5
Silicon, total	µg/L	4700	28200	9700	58200	3500	21000		
Silver, dissolved	µg/L	< 10.	30	< 10.	30	<0.5	1.5	100	
Sodium, total	mg/L	4.6	27.6	14	84	4.6	28		
Sulfate	mg/L	5	30	8	48	<5	15	250	
Sulfide, total	mg/L	< 0.02	0.06	< 0.02	0.06	<0.05	0.15		
Thallium, dissolved	µg/L	< 1.	3	< 1.	3	<1	3	2	1.7
Total dissolved solids	mg/L	50	300	70	420	62	372	500	
Total inorganic carbon	mg/L	23	138	27	162	26	156		
Total organic carbon	mg/L	0.5	3	0.2	1.2	<1	3		
Total suspended solids	mg/L	< 1.	3	5	30	<1	3		
True color	PC Units	15	90	10	60	17	102		
Turbidity	NTU	1	6	3	18	0.48	2.9		
Zinc, dissolved	µg/L	20	120	20	120	<10	30	5000	120
Zinc, total	µg/L	20	120	10	60	<10	30	5000	

Water quality data for local aquifers
(used 1/2 detection limits in x6 calculations)

Table 6. Lagoon Creek Cooling Tower Estimated Blowdown Chemistry

Constituent, mg/L Except as Noted	CT Makeup	6 Cycles Blowdown	8 Cycles Blowdown
Flow, gpm	Variable	457	322
pH, standard units	6.5	7.4	7.4
Specific Conductance, 25°C, µmhos	105	737	996
Alkalinity, "M," as CaCO3	49	70	70
Sulfur, total as SO4	BDL	187	271
Chloride as Cl	1.4	8	11
Phosphate, total as PO4	0.0	16	16
Nitrate, as NO3	BDL	BDL	BDL
Silica, total as SiO2	8.7	52	70
Calcium, total as CaCO3	26	156	208
Magnesium, total as CaCO3	14.3	86	114
Sodium as Na	3.6	22	29
Aluminum, total as Al	BDL	BDL	BDL
Barium as Ba	0.01	0.06	0.08
Iron, total as Fe	0.6	3.6	4.8
Manganese, total as Mn	BDL	BDL	BDL
Potassium as K	0.7	4.2	5.6
AEC	0.0	9.0	9.0
Terpolymer	0.0	8.0	8.0
Strontium as Sr	0.05	0.30	0.48
Total suspended solids		ND	ND
Total organic carbon, as C	BDL	BDL	BDL

ND-No data available
BDL-Below detectable limits

Notes:
(1) Chlorides in CT blowdown will be variable based primarily on bleach feed
(2) CT blowdown flow will be variable based primarily on cycles of concentration
(3) Phosphate, AEC (alkyl epoxy carboxylate), and terpolymer are added directly to the cooling tower per the treatment program

Environmental Consequences

A. Construction

Storm Water

The use of storm water BMPs to mitigate any erosion would result in no significant impacts.

Sanitary Wastewater

Use of temporary toilet facilities, trucked to a suitable and permitted sewage disposal facility for disposal, would result in no significant impacts.

B. Operation

Storm Water

Again, use of storm water BMPs combined with off-site disposal of any oily wastewater would result in no significant impacts.

Sanitary Waste Water

Proper operation and maintenance of a permitted septic tank/drain field system for sanitary wastewater would result in no significant impacts.

Process Wastewater

A biocide may be dosed to the cooling towers intermittently to control biological slimes in the cooling towers. If and when a biocide is added to the cooling towers, cooling tower blowdown would be halted for approximately four hours both to provide maximum effectiveness for the biocide and to prevent discharge of any significant amount of biocide. This interruption of blowdown, combined with the retention time in the process wastewater pond, would result in no significant impact from the biocides utilized in the cooling tower system.

As seen in both Tables 5 and 6, highlighted in red, the parameter likely to be of concern is iron. The groundwater data show that most of the iron will begin as dissolved iron (probably ferrous). This ferrous iron would quickly oxidize to ferric iron and precipitate in the cooling towers under the expected pH values. To prevent iron scaling in the cooling tower system, the iron in the source groundwater would be maintained in a dispersed state by carefully dosed cooling water treatment chemicals until it reached the process wastewater treatment pond.

In TVA's best professional judgment, the dispersed iron would quickly oxidize and precipitate in the process wastewater treatment pond. Several studies have shown that many metals present in complex wastewaters adsorb and co-precipitate when ferrous iron oxidizes and precipitates from those wastewaters as oxyhydroxides. However, if the iron is not being adequately removed to NPDES narrative permit requirements in the process pond, additional treatment, such as baffles to increase retention time, or coagulation with polymers, or filtration, would be added to ensure the final effluent met all applicable permit limitations.

TVA expects the NPDES permit for the proposed facility to contain requirements for whole effluent toxicity (WET) testing in addition to any specific limitations on individual constituents that TDEC deems necessary to protect the receiving stream. If the WET testing reveals any potential impacts to Lagoon Creek, TVA would use an adaptive management approach to determine the source of the toxicity and address the source with appropriate process modifications or wastewater treatment alternatives. Therefore, the expected process wastewaters would result in no significant impacts.

ENVIRONMENTAL NOISE

Affected Environment

At high levels, noise can cause hearing loss; at moderate levels, noise can interfere with communication, disrupt sleep, and cause stress; and at low levels, noise can cause annoyance. Noise is measured in decibels (dB), a logarithmic unit, so an increase of 3 dB is just noticeable, and an increase of 10 dB is perceived as a doubling of sound level. Since not all noise frequencies are perceptible to the human ear, A-weighted decibels (dBA), which filter out sound in frequencies above and below human hearing, were used for this assessment. C-weighted decibels (dBC) are sometimes used to characterize noise dominated by low frequencies. While human hearing is less sensitive to low-frequency noise, it can cause vibrations that result in rattling of household objects and structures.

Community noise is assessed using an equivalent sound level day/night (Ldn), which is a 24-hour average sound level with 10 dB added to hours between 10 p.m. and 7 a.m., since noise at night has the potential to cause sleep disruption. There are no federal, state, or local regulations for community noise in Haywood County; however, USEPA recommends a guideline of Ldn not to exceed 55 dBA (USEPA 1973). The Federal Interagency Committee on Noise (U.S. Air Force et al. 1992) determined that a 5-dB increase above background levels at Ldn 55, a 3-dB increase above background levels at Ldn 60, and a 1.5-dB increase above background levels at Ldn 65 all represent the same percentage increase and are all equally discernable.

Annoyance from noise is highly subjective. The Federal Interagency Committee on Noise (ibid) used population surveys to correlate annoyance and noise exposure. Table 7 generically estimates the percentage of residential population that would be highly annoyed from a range of background noise and the average community reaction description that would be expected.

Table 7. Estimated Annoyance From Background Noise

Ldn (dBA)	Percent Highly Annoyed	Average Community Reaction
75 and above	37	Very severe
70	25	Severe
65	15	Significant
60	9	Moderate
55 & below	4	Slight

Source: U.S. Air Force 1992

According to TVA 2000, before the construction of the SC CTs, background noise levels at Lagoon Creek ranged from 43 to 47 dBA (Table 8). The A-weighted decibel scale was used since this scale more accurately reflects the response of the human ear to noise. These measurements of background noise are typical of rural areas with minimum noise from traffic. Noise sources included agricultural equipment, road traffic, residential activities, and animals.

Table 8. Background Noise Levels (dBA) Prior to Construction of Lagoon Creek Simple-Cycle Plant

	Day Ld	Evening Le	Night Ln	Average Leq
NE Perimeter on Elm Tree Road	46.3	44.9	44.1	45.4
SE Perimeter on Hudson Lane	48.1	46.8	44.9	47.0
SW Perimeter on Hudson Lane	45.7	41.8	41.9	44.2
NW Perimeter on Elm Tree Road	45.1	39.5	40.2	43.3

Ld – day noise levels, Le – evening noise levels, Ln – night noise levels
Leq – Average A-weighted sound level
Source: TVA 2000

There are few sensitive noise receptors (such as residences, cemeteries, etc.) surrounding the Lagoon Creek site. Four homes in the vicinity of the site were identified ranging from 0.7 to 1.4 miles from the Lagoon Creek SC site and from 1.0 to 1.4 miles from the LCCC site. Figure 7 indicates where these sensitive receptors are located.

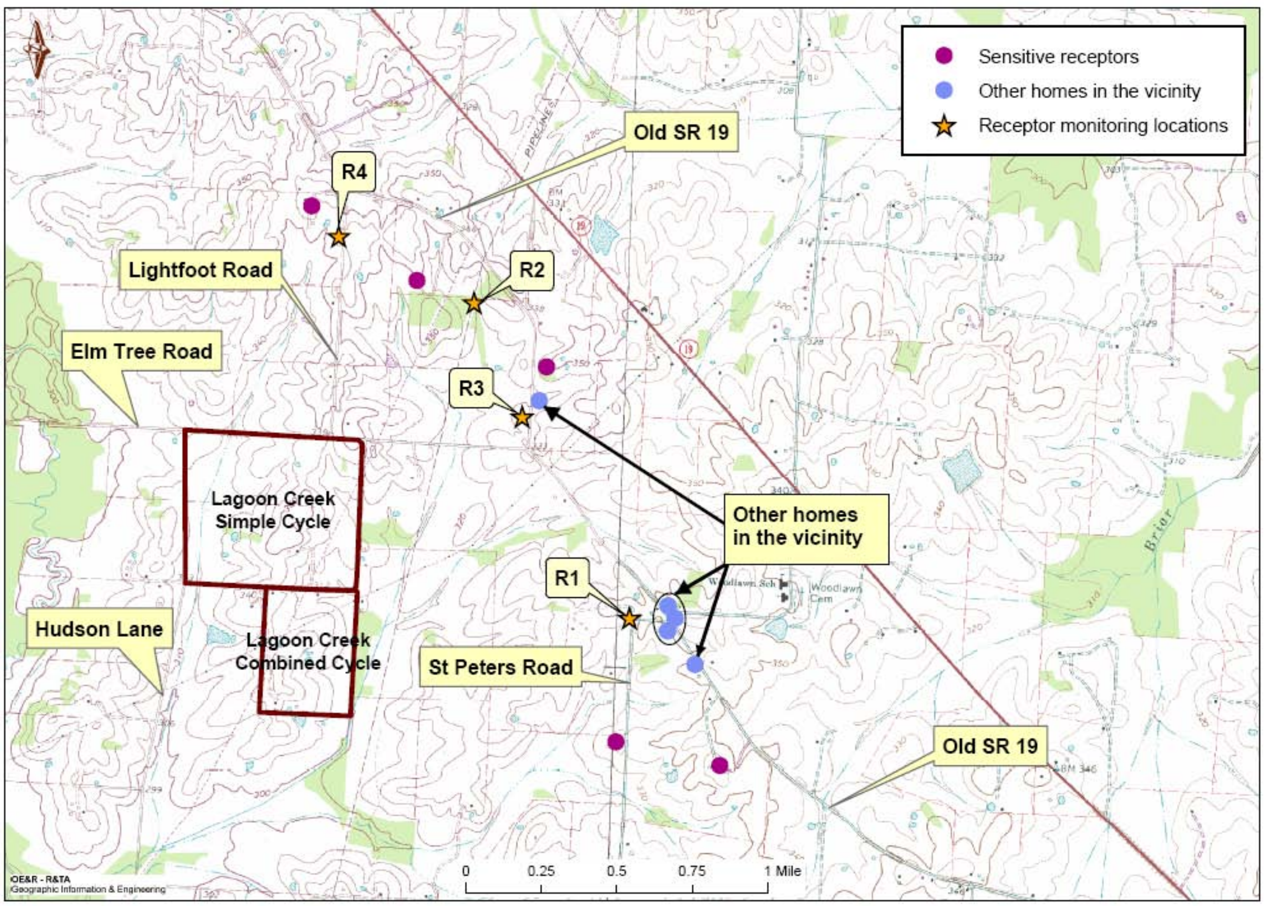


Figure 7. Sensitive Receptor Sites

There are currently 12 SC CTs at Lagoon Creek SC. Noise levels (Leq) at the nearest residence, Receptor #2 (R2) in Figure 7, are approximately 46 dBA when one CT is operating and 57 dBA when all 12 CTs are operating (Table 9). Lagoon Creek SC CTs are used for peaking power and are only operated during the hottest and coldest months of the year. When they operate, they typically operate from noon to 8 p.m. on summer days and from 5 a.m. to 10 a.m. and 5 p.m. to 9 p.m. on winter days. Average daily noise levels with a 10-dB penalty at night, Ldn, at nearby residences range from 49 dBA to 51 dBA when all 12 SC CTs are operating (Table 10). Average daily noise levels would be less when fewer CTs are operating.

Table 9. Intruding Noise from Lagoon Creek Simple Cycle Plant – Leq (dBA)

Plant Operating Scenario	400 Feet From Plant	Receptor #1	Receptor #2	Receptor #3	Recepto r #4
1 CT operating	66	41	46	44	45
4 CTs operating	72	47	52	50	51
8 CTs operating	75	50	55	53	54
12 CTs operating	77	52	57	55	56
Plant background	55	30	35	33	34

Source: TVA 2002

Table 10. Average Daily Noise Levels (dBA) at Nearby Residences

	Recepto r #1	Recepto r #2	Receptor #3	Recepto r #4
Background (dBA)	47	46	45	46
Daily summer Ldn with 12 SC CTs operating	49	50	49	50
Daily winter Ldn with 12 SC CTs operating	50	51	50	51

Environmental Consequences

IMPACTS OF CONSTRUCTION

Construction activities would last from 12 to 24 months. Most of the work would occur during the day on weekdays; however, construction activities could occur at night or on weekends, if necessary. Construction activities would increase traffic on roads in the vicinity of Lagoon Creek, which would also increase intermittent noise at some nearby residences. During the first phase of construction, noise would be generated by compactors, front loaders, backhoes, graders, and trucks. The second phase would involve concrete mixers, cranes, pumps, generators, and compressors. The final phase would not generate a significant amount of noise. Due to the temporary and intermittent nature of construction and the site’s rural location, the impacts of noise from construction activities are not expected to cause adverse impacts.

IMPACTS OF OPERATION

Both the A-weighted and C-weighted noise levels generated by various equipment associated with the proposed CC CTs are shown in Table 11. This table also shows the far-field noise levels (at 400 feet from the source) for different noise sources at the proposed CC CT site. When adding logarithms, such as noise measurements, simple addition cannot be used. For example, adding two noise measurements of 50 dB and 50 dB equals 53 dB, not 100 dB. Therefore, the sum of all sources in Table 11 is calculated with logarithmic addition, not simple addition.

Table 11. Noise Emissions of Equipment at Combined-Cycle Combustion Turbines

Noise Source	Sound Power Level (dBA)	Sound Power Level (dBC)	Sound Pressure Level at 400 feet (dBA)
Cooling towers – 10 cells	115	124	59
Steam turbine condenser	114	121	58
Air inlet	113	120	57
Exhaust stack	112	124	56
HRSG inlet expansion joint	111	123	55
Combustion turbine generator, Mitsubishi 501Fs	108	116	52
Steam turbine, General Electric	105	110	49
Steam turbine generator	105	110	49
HRSG inlet duct work	104	116	48
Main transformer	104	115	48
Boiler feed pumps	104	106	48
Steam turbine building exhaust fan	103	111	47
Fin fan cooler	102	112	46
Steam turbine building roof intake vent	101	109	45
HRSG SCR duct work	95	106	39
Auxiliary pumps	95	97	39
HRSG last module	94	106	38
Air compressor	93	93	37
Auxiliary transformer	92	100	36
Sum of all sources	121	130	65

Source: Edison Electric Institute (1984)

The CC CTs would operate far more frequently than the SC CTs. The CC CTs may operate 24 hours a day for 25 percent of the year and from 6 a.m. to 10 p.m. for the other 75 percent of the year.

TVA predicted the increase in daily noise levels when both the SC and CC CTs are operating simultaneously compared to the SC CTs operating alone. The increase in daily Ldn ranges from 1 to 3 dBA (Table 12). This assumes the SC CTs operate on winter schedule (5 a.m. to 10 a.m. and 5 p.m. to 8 p.m.) and CC CTs operate 24 hours per day, which is the “worst-case” scenario. The increase in daily Ldn would be less when the CC CTs operate from 6 a.m. to 10 p.m., which is expected to occur approximately 75 percent of the time. Table 12 also indicates that daily Ldn is not expected to exceed USEPA’s recommended guideline of 55 dBA at any of the sensitive receptors.

Table 12. Predicted Daily Noise Levels When Simple Cycle and Combined Cycle Combustion Turbines are Operating Simultaneously

	Receptor #1	Recepto r #2	Receptor #3	Receptor #4
Distance from CC CTs (mile)	1.0	1.2	1.2	1.4
Distance from SC CTs (mile)	1.4	0.7	1.0	0.8
Daily Ldn for SC CTs on winter schedule (dBA)	48	51	49	50
Daily Ldn for SC and CC CTs operating simultaneously (dBA)	51	52	51	51
Increase in daily Ldn (dBA)	3	1	2	1

Ldn assumes SC CTs operate on winter schedule (5 a.m. to 10 a.m. and 5 p.m. to 8 p.m.) and CC CTs operate 24 hours per day, which is the "worst-case" scenario.

TVA also predicted the increase in annual noise levels from the CC CTs at nearby receptors compared to "greenfield" background noise levels. This increase in annual noise levels is expected to range from 1 to 3 dBA (Table 13). This is a conservative estimate since it is based on "greenfield" background levels without considering noise from the SC CTs that are currently operating at the site.

Table 13. Predicted Noise Levels Above "Greenfield" Background Noise Levels at Nearby Sensitive Receptors

	Receptor #1	Receptor #2	Receptor #3	Receptor #4
Distance from LCCC (mile)	1.0	1.2	1.2	1.4
Background noise (dBA) "greenfield"	47	46	45	46
Intruding noise Leq (dBA)	42	41	41	39
Annual Ldn	49	48	48	47
Increase in annual Ldn (dBA)	2	2	3	1

Based on this analysis, noise from the proposed CC CTs would not cause Ldn noise levels above 55 dBA at any of the nearby sensitive receptors, and the increase in Ldn is expected to be 3 dBA or less. Therefore, while the addition of CC CTs would increase noise in the vicinity of Lagoon Creek CTs, it would not have an adverse impact on noise at nearby sensitive receptors.

AIR QUALITY

Affected Environment

Air quality is an environmental resource value that is considered important to most people. Through its passage of the Clean Air Act (CAA), Congress has mandated the protection and enhancement of our nation's air quality resources. National Ambient Air Quality Standards for the following criteria pollutants have been set to protect the public health and welfare:

- Sulfur dioxide (SO_2)
- Ozone (O_3)
- Nitrogen dioxide (NO_2)

- Particulate matter whose particles are <= 10 micrometers (PM_{10})
- Particulate matter whose particles are <= 2.5 micrometers ($PM_{2.5}$)
- Carbon monoxide (CO)
- Lead (Pb)

PSD regulations have been established to ensure that areas with good air quality do not lose this desirable status. A listing of the national air quality standards is given in Table 14.

Table 14. National Ambient Air Quality Standards

Pollutant	Primary[a]	Secondary[b]
Sulfur dioxide	0.14-ppm (365-μg/m^3) maximum 24-hour concentration not to be exceeded more than once per year 0.03-ppm (80-μg/m^3) annual arithmetic mean	0.5-ppm (1,300 μg/m^3) maximum 3-hour concentration not to be exceeded more than once per year
Ozone (new standard)	0.075 ppm based on the average of the fourth-highest daily maximum 8-hour concentration during each ozone season (currently April 1-October 31) for each of three consecutive years	Same as primary standard
Nitrogen dioxide	0.053-ppm (100-μg/m^3) annual arithmetic mean	Same as primary standard
Carbon monoxide	35-ppm (40-mg/m^3) maximum 1-hour concentration not to be exceeded more than once per year 9-ppm (10 mg/m^3) maximum 8-hour average concentration not to be exceeded more than once per year	None
$PM_{2.5}$ (new standard)[c]	15-μg/m^3 annual average 35 μg/m^3 (24-hour average)	Same as primary standard
PM_{10}	150-μg/m^3 maximum 24-hour average concentration with an expected exceedance of no more than one per year based upon a three-year average	Same as primary standard
Lead	1.5-μg/m^3 maximum quarterly arithmetic mean	Same as primary standard

Source: 40 Code of Federal Regulations (CFR) Part 50, as currently amended
a - Standards set to protect public health
b - Standards set to protect public welfare

National standards, other than annual standards, are not to be exceeded more than once per year (except where noted). Units are ppm by volume of air except for particulate matter (PM) and lead, which are expressed in micrograms per cubic meter (μg/m^3).

The feasibility of locating a CT plant at a given site may be affected by several air quality considerations. Among the factors are dispersion conditions (nearby high terrain, frequency of air stagnation) and regulatory status (attainment of air quality standards, proximity to PSD Class I area). Regulatory constraints that may influence siting decisions are embodied in the New Source Review (NSR) provisions of the CAA and in U.S. Environmental Protection Agency (USEPA) PSD regulations (USEPA 1998). Sources locating in clean air areas are subject to the PSD NSR rules; whereas, those locating in or affecting areas failing to attain air quality standards must comply with nonattainment NSR. An overriding constraint in either NSR program is that no source may cause or significantly contribute to a violation of an ambient air quality standard.

New sources in nonattainment areas are subject to more stringent control requirements than new sources in areas that are in attainment of standards (lowest achievable emission rate versus best available control technology [BACT]). New sources in nonattainment areas are also subject to emission offset rules. Offset rules require the source owner to obtain certain reductions in emissions from existing sources within the affected nonattainment area to accommodate the new proposed emissions.

PSD rules restrict the increment by which ambient pollutant levels may increase due to emissions from major new sources, or the modification of existing sources, and require the use of BACT on such sources. A CC CT facility would be a major source if it emits more than 100 tons per year of any PSD-regulated pollutant. An SC CT facility would be a major source if it emits more than 250 tons per year of any PSD-regulated pollutant. The proposed plant is a CC facility. A memorandum listing pollutants currently subject to PSD review was published in the April 28, 1992, *Federal Register* (USEPA 1992). Generally, dispersion modeling (as included in this EA) is required to demonstrate that pollution levels do not increase beyond the allowable increments. For the site considered in this EA, ambient air quality data necessary for PSD analysis purposes are available. The PSD modeling, however, demonstrated that impact area for all pollutants was less than the PSD significance levels.

More stringent PSD increments apply for sources affecting specially protected areas (PSD Class I) such as national parks and wilderness areas. Dispersion analyses are generally required for sources subject to PSD review that are within 100 kilometers (km) (approximately 62 miles) of such an area. The closest Class I area is Mingo Wilderness Area, about 101 miles (162 km) northwest in Missouri. The next two are Sipsey Wilderness Area, 139 miles (224 km) southeast in Alabama, and Mammoth Cave National Park, 205 miles (329.8 km) northeast in Kentucky. As part of the PSD permitting process, discussions were held with the federal land managers responsible for these areas. An analysis of potential air impacts on the air quality related values of concern was included in the PSD permit application.

Table 15 gives the results of ambient air quality monitoring of criteria pollutants that are considered representative of the site. Both Haywood and nearby Madison counties are currently in attainment for all criteria pollutants. Nearby Shelby County is nonattainment for ozone.

Table 15. Ambient Concentrations of Criteria Air Pollutants Compared With Air Quality Standards

Pollutant	Level of Standard (ppm)[a]	One-Year Maximum or Mean	
		Concentration (ppm)[a]	Percent of Standard (%)
Ozone (new standard)	Fourth-highest 8-hour average (0.075)	0.066[b]	88
Sulfur dioxide	Maximum 3-hour average (0.5) Maximum 24-hour average (0.14) Annual mean (0.030)	0.024[b] 0.006[b] 0.0013[b]	5 4 4
Nitrogen dioxide	Annual mean (0.053)	0.0026[b]	5
Carbon monoxide	Maximum 1-hour average (35) Maximum 8-hour average (9)	3.1[c] 2.4[c]	9 27
PM_{10} (old standard) $PM_{2.5}$ (new standard)	($\mu g/m^3$) Maximum 24-hour average (150) Annual average (15) 24-hour average (35)	($\mu g/m^3$) 62[d] 12.9[d] 33.5[d]	41 86 96
Lead	($\mu g/m^3$) Quarterly mean (1.5)	($\mu g/m^3$) 0.01[e]	1

a - ppm unless otherwise noted
b - Ozone 8-hour, sulfur dioxide, and nitrogen dioxide values for Haywood County, Tennessee, 2007
c - Carbon monoxide values for Shelby County, Tennessee, 2007
d - PM_{10} and $PM_{2.5}$ values for Madison County, Tennessee, 2007; annual average for $PM_{2.5}$ is average of two different monitors at the same site; 24-hour average for $PM_{2.5}$ is average of two 98th percentile values for two different monitors at the same site
e - Lead value for Shelby County, Tennessee, 2004

Environmental Consequences

IMPACTS OF CONSTRUCTION

The facility under consideration would have associated transient air pollutant emissions during the construction phase of the project. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Land clearing, site preparation, and vehicular traffic over unpaved roads and the construction site result in the emission of fugitive dust PM during site preparation and active construction periods. The largest fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of the dust would be subject to transport beyond the property boundary. If necessary, emissions from open construction areas and unpaved roads could be mitigated by spraying water on the roadways as needed to reduce fugitive dust emissions by as much as 95 percent.

Combustion of gasoline and diesel fuels by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, NOx, CO, volatile organic compounds, and sulfur dioxide during the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site impacts.

Air quality impacts from construction activities would be temporary and dependent on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality and be well below the applicable ambient air quality standard. Overall, the air quality impact of construction-related activities for the project would not be significant.

IMPACTS OF OPERATION

TVA is proposing to construct a new, highly efficient gas-fired CC CT plant adjacent to its Lagoon Creek CT facility near Brownsville, Tennessee, to meet future power demands. The new units would burn natural gas. If constructed, total capacity under standard conditions would be approximately 600 MW. These units would be permitted to operate in intermediate- to base-load mode; however, current projections indicate that the units would operate more toward the intermediate-load capacity.

Description of Analysis

An air quality analysis was performed in accordance with USEPA's *Guidelines on Air Quality Models* (USEPA 1996). The focus of the analysis was to determine the air quality impacts of each pollutant on the area surrounding the proposed facility.

Refined modeling was performed using the AERMOD model. Short-term emissions were used to model the impacts of pollutants with an averaging time of 24 hours or less (i.e., CO and PM_{10}). However, annual emissions estimates were used in estimating impacts of NO_2, for which there is only an annual air quality standard. Modeling runs were made using detailed receptor sets and representative hourly meteorology. Descriptions of the dispersion models, data requirements, and modeling results are presented in the following sections.

Sources

The combustion sources at the proposed Lagoon Creek facility included in the air quality modeling are listed in Table 16.

Table 16. Emissions Sources

Stack Name	Stack Identification
CT/HRSG exhaust stack – West	HRSGW
CT/HRSG exhaust stack – East	HRSGE
Auxiliary boiler	AXB
Fuel gas heater West Stack #1	GH1
Fuel gas heater West Stack #2	GH2
Fuel gas heater East Stack #1	GH3
Fuel gas heater East Stack #2	GH4
Cooling tower (10 cells)	CTWR1-CTWR10

The stack physical dimensions and locations of each source are presented below in Table 17.

Table 17. Stack Locations and Physical Dimensions

Equipment	Easting (m)	Northing (m)	Stack Base Elevation (feet, msl)	Stack Height (m)	Stack Diameter (m)
HRSGW	283356	3947761	316	57.91	6.25
HRSGE	283404	3947759	316	57.91	6.25
AXB	283437	3947777	316	15.24	0.81
GH1	283269	3947802	325	11.49	0.76
GH2	283271	3947802	325	11.49	0.76
GH3	283276	3947801	325	11.49	0.76
GH4	283278	3947801	325	11.49	0.76
CTWR1	283456	3947702	316	16.09	11.35
CTWR2	283452	3947686	316	16.09	11.35
CTWR3	283448	3947670	316	16.09	11.35
CTWR4	283444	3947654	316	16.09	11.35
CTWR5	283440	3947638	316	16.09	11.35
CTWR6	283436	3947622	316	16.09	11.35
CTWR7	283432	3947606	316	16.09	11.35
CTWR8	283428	3947590	316	16.09	11.35
CTWR9	283424	3947574	316	16.09	11.35
CTWR10	283420	3947558	316	16.09	11.35

Emissions

Modeling was performed for different combinations of CT operating conditions based on CT loading of 50 percent, 75 percent, or 100 percent, and for minimum ambient temperatures of 0 degrees Fahrenheit (ºF) and 20ºF. The use of duct firing and CT startup/shutdown impacts were assessed. Emission estimates from a cold startup are greater than those of a hot or warm startup, so their impacts were modeled as a worst-case scenario.

Short-term maximum emissions were used to model the impacts of pollutants with an averaging time of 24 hours or less (i.e., CO and PM_{10}). However, annual emissions were used in estimating impacts of NO_2, for which there is only an annual PSD significance level.

Modeling scenarios were developed for cyclic-mode as well as base-mode CT operations during extreme cases to make sure impacts of worst-case emissions from the facility would not be above the PSD significance levels. For all scenarios, the worst-case emissions from the auxiliary boiler, fuel gas heaters, and cooling tower cells were included in the modeling regardless of CT operating capacity.

Flue gas parameters and emission rates used in each modeling scenario, along with a description of each modeling scenario, are presented in Tables 18-25.

Table 18. Scenario 1A: Cyclic-Mode Emission Estimates for 100 Percent CT Load at 0 Degrees Fahrenheit With Max Duct Firing and Online Emission-Control Equipment

Equipment	Stack Flow Parameters		Short-Term Max Stack-Exit Emissions (g/s)	
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	CO	PM_{10}
HRSGW	16.79	357.2	3.61E+00	1.03E+00
HRSGE	16.79	357.2	3.61E+00	1.03E+00
AXB	13.51	433.2	6.76E-01	6.15E-02
GH1	1.43	477.6	3.64E-02	4.06E-03
GH2	1.43	477.6	3.64E-02	4.06E-03
GH3	1.43	477.6	3.64E-02	4.06E-03
GH4	1.43	477.6	3.64E-02	4.06E-03
CTWR1-CTWR10	7.30	290.5	0.00E+00	4.56E-03

Table 19. Scenario 2A: Cyclic/Base-Mode Emission Estimates for 50 Percent CT Load at 0 Degrees Fahrenheit With No Duct Firing and No Ammonia Inputs to Selective Catalytic Reduction Reactor

Equipment	Stack Flow Parameters		Short-Term Max Stack-Exit Emissions (g/s)	
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	CO	PM_{10}
HRSGW	12.72	370.4	2.52E+00	4.81E-01
HRSGE	12.72	370.4	2.52E+00	4.81E-01
AXB	13.51	433.2	6.76E-01	6.15E-02
GH1	1.43	477.6	3.64E-02	4.06E-03
GH2	1.43	477.6	3.64E-02	4.06E-03
GH3	1.43	477.6	3.64E-02	4.06E-03
GH4	1.43	477.6	3.64E-02	4.06E-03
CTWR1-CTWR10	7.30	290.5	0.00E+00	4.56E-03

Table 20. Scenario 3A: Base-Mode Emission Estimates for 100 Percent CT Load at 20 Degrees Fahrenheit With No Duct Firing and Online Emission-Control Equipment

Equipment	Stack Flow Parameters		Short-Term Max Stack-Exit Emissions (g/s)	
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	CO	PM_{10}
HRSGW	16.30	359.9	3.25E+00	6.87E-01
HRSGE	16.30	359.9	3.25E+00	6.87E-01
AXB	13.51	433.2	6.76E-01	6.15E-02
GH1	1.43	477.6	3.64E-02	4.06E-03
GH2	1.43	477.6	3.64E-02	4.06E-03
GH3	1.43	477.6	3.64E-02	4.06E-03
GH4	1.43	477.6	3.64E-02	4.06E-03
CTWR1-CTWR10	7.30	290.5	0.00E+00	4.56E-03

Table 21. Scenario 4A: Base-Mode Emission Estimates for 100 Percent CT Load at 0 Degrees Fahrenheit With Max Duct Firing and Online Emission-Control Equipment

Equipment	Stack Flow Parameters		Short-Term Max Stack-exit Emissions (g/s)	
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	CO	PM_{10}
HRSGW	16.79	357.2	3.61E+00	1.03E+00
HRSGE	16.79	357.2	3.61E+00	1.03E+00
AXB	13.51	433.2	6.76E-01	6.15E-02
GH1	1.43	477.6	3.64E-02	4.06E-03
GH2	1.43	477.6	3.64E-02	4.06E-03
GH3	1.43	477.6	3.64E-02	4.06E-03
GH4	1.43	477.6	3.64E-02	4.06E-03
CTWR1-CTWR10	7.30	290.5	0.00E+00	4.56E-03

Table 22. Scenario 5A: Cyclic/Base-Mode Emission Estimates for 75 Percent CT Load at 0 Degrees Fahrenheit With No Duct Firing and Online Emission-Control Equipment

Equipment	Stack Flow Parameters		Short-Term Max Stack-Exit Emissions (g/s)	
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	CO	PM_{10}
HRSGW	16.22	369.9	2.54E+00	6.32E-01
HRSGE	16.22	369.9	2.54E+00	6.32E-01
AXB	13.51	433.2	6.76E-01	6.15E-02
GH1	1.43	477.6	3.64E-02	4.06E-03
GH2	1.43	477.6	3.64E-02	4.06E-03
GH3	1.43	477.6	3.64E-02	4.06E-03
GH4	1.43	477.6	3.64E-02	4.06E-03
CTWR1-CTWR10	7.30	290.5	0.00E+00	4.56E-03

Table 23. Scenario 14A: Daily-Average Emission Estimates for Cold Startup Followed by Base-Mode Operations at 100 Percent CT Load at 0 Degrees Fahrenheit With Duct Firing Then Shutdown

Equipment	Stack Flow Parameters		Short-Term Max Stack-Exit Emissions (g/s)	
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	CO	PM_{10}
HRSGW	15.89	360.7	2.59E+01	8.72E-01
HRSGE	16.41	358.0	1.34E+01	9.69E-01
AXB	13.51	433.2	6.76E-01	6.15E-02
GH1	1.43	477.6	3.64E-02	4.06E-03
GH2	1.43	477.6	3.64E-02	4.06E-03
GH3	1.43	477.6	3.64E-02	4.06E-03
GH4	1.43	477.6	3.64E-02	4.06E-03
CTWR1-CTWR10	7.30	290.5	0.00E+00	4.56E-03

Table 24. Scenario 6A: Annual-Average Cyclic-Mode Emission Estimates (Including Startup/Shutdown)

Equipment	Stack Flow Parameters		Annual-Average Stack-Exit Emissions (g/s)
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	NOx
HRSGW	16.44	358.0	2.53E+00
HRSGE	16.48	357.8	2.32E+00
AXB	13.51	433.2	6.32E-02
GH1	1.43	477.6	2.41E-02
GH2	1.43	477.6	2.41E-02
GH3	1.43	477.6	2.41E-02
GH4	1.43	477.6	2.41E-02
CTWR1-CTWR10	7.30	290.5	7.90E-05

Table 25. Scenario 7A: Annual-Average Base-Mode Emission Estimates (Including Startup/Shutdown)

Equipment	Stack Flow Parameters		Annual-Average Stack-Exit Emissions (g/s)
	Stack Exit Velocity (m/s)	Stack Exit Temperature (K)	NOx
HRSGW	16.50	358.7	2.45E+00
HRSGE	16.50	358.7	2.44E+00
AXB	13.51	433.2	6.32E-02
GH1	1.43	477.6	2.41E-02
GH2	1.43	477.6	2.41E-02
GH3	1.43	477.6	2.41E-02
GH4	1.43	477.6	2.41E-02
CTWR1-CTWR10	7.30	290.5	7.90E-05

Air Quality Dispersion Model

Air quality dispersion modeling was performed using the American Meteorological Society /USEPA regulatory model (AERMOD) (Version 07026) to obtain estimates of maximum ambient impacts. As of December 9, 2006, AERMOD is fully promulgated as a replacement to ISC3 as USEPA's preferred regulatory model, in accordance with USEPA guidance (2005).

The options used within the model were the recommended default regulatory options, which include the following:

- Stack tip downwash
- Calms and missing meteorological data routine
- Direction-specific building downwash
- Actual receptor elevations
- Complex/intermediate terrain algorithms

Technical details on AERMOD are presented in USEPA 2004.

Receptors

The modeling was performed using two receptor sets for a total of 2,281 receptors. The first receptor set consists of boundary receptors that were placed along the perimeter of the fenced area and are spaced 50 meters apart. These boundary receptors correspond to a permanent fence.

Additionally, nested receptor grids surround the facility site with the exception of those falling inside the fenced boundary area, which were removed. Since concentration gradients are most pronounced near a source, the receptor spacing varied with distance from the site, with those nearest the site more closely spaced than those farther away. The origin of each grid is located in the southwest corner. The initial receptor spacing is outlined in Table 26 below.

Table 26. Receptor Grid Size and Spacing

Receptor Spacing (m)	Grid Size (km)	Grid Origin (km south and west of site)
100	1.4 x 1.4	0.75
250	4.75 x 4.75	2.5
500	9.5 x 9.5	5
1000	24 x 24	12.5
2000	48 x 48	25

Elevations for all receptors were extracted from 7.5-minute U.S. Geological Survey (USGS) Digital Elevation Model files using the AERMAP module of the AERMOD modeling system.

Building Downwash

The potential for building downwash for the CTs, auxiliary boiler, gas heaters, and cooling tower was accounted for in the modeling. The major structures located on the facility site are:

- Steam turbine building
- Two heat recovery steam generators
- Auxiliary boiler building
- Control building
- Mechanical draft cooling tower

Direction-specific effective building widths and heights were calculated using USEPA's Building Profile Input Program for PRIME (dated 04274).

Meteorology

Given that site-specific meteorological data were not available for the Lagoon Creek site, National Weather Service (NWS) surface meteorological data from two nearby stations were evaluated to determine which was more representative for use in the regulatory dispersion modeling. The two sites evaluated were Memphis International Airport; Memphis, Tennessee, and Tupelo C.D. Lemons Airport; Tupelo, Mississippi. In reviewing direction-specific land use data within a 3-km radius for both the meteorological stations and the project site, it was determined that Tupelo was the closest land use match to the proposed site. However, it is located 88 miles from the proposed facility site location as opposed to the Memphis NWS site, which is located 58 miles from the site.

Following the request of TDEC, the modeling was performed using five years of data from each of the NWS stations in the analysis. Modeling results from the worst case are reported. Actual surface data collected by the NWS at the Memphis, Tennessee, airport for the years 2001-2005 were used in addition to the same five years collected at the Tupelo NWS surface site. Twice daily soundings for the same time period from the airport in North Little Rock, Arkansas, were used for the upper air data. Data were processed using the AERMET (dated 06341) meteorological data preprocessor for AERMOD.

Processing of meteorological data with AERMET occurs in three stages. Stage 1 has two steps in which the hourly surface data and upper air data are extracted from the raw data files and quality assured. In Stage 2, the processing occurs that merges the hourly surface observations and upper air soundings into a single file. Finally, Stage 3 establishes the boundary layer parameters from the merged data and creates the two meteorological files, which are input meteorology for AERMOD.

Calculations of the boundary layer parameters are dependent on the surface characteristics in the vicinity of the modeled facility. The surface characteristics were evaluated by reviewing land use data, which revealed that the area within a 3-km radius of the site is primarily cropland with some areas of deciduous forest. The surface characteristics are quantified in the meteorological processor by the assignment of three variables: surface albedo, Bowen ratio, and surface roughness length. Values were set for each parameter and each meteorological station site, as specified in the AERMET user's guide, and were set to vary by season. A weighted average of characteristics by surface area within each 30-degree sector surrounding the facility was used to determine the appropriate value for each surface characteristic parameter.

A detailed evaluation was performed that included the directional-specific surface characteristics at both meteorological stations and the project location.

Air Quality Modeling Results

AERMOD modeling was performed to demonstrate that ambient impacts due to emissions from the proposed facility would be less than the PSD Class II significance levels. The modeling was performed with the meteorological data and receptor sets described above.

A summary of the worst-case modeling results for each pollutant is presented in Table 27 below. The maximum concentrations occurred at receptors where spacing was 100 meters or less apart. Modeling results show that maximum modeled impacts occur when using the Tupelo, Mississippi, NWS meteorological data. Scenarios 1A, 3A, 5A, and 14A resulted in the highest modeled concentrations for CO short-term averaging periods, while Scenarios 2A, 4A, and 14A showed the highest results for the 24-hour PM_{10} averaging period. The highest annual NOx concentration occurs for modeling Scenario 7A. In reviewing source group contribution information, it was determined that the gas heaters, which have the same emissions contribution in all modeling scenarios, were the primary contributors to modeled pollutant concentrations.

Table 27. Modeling Results – Estimated Maximum Impacts in the Lagoon Creek Area

Pollutant	Meteorology	Average Type	Receptor				Ending Time			Conc. ($\mu g/m^3$)	PSD Significance Level ($\mu g/m^3$)
		Highest	No.	East (km)	North (km)	Elev. (feet, msl)	Year	Day	Hour		
CO	Tupelo	8-hr	19	283571	3947731	94.2	2005	362	24	67.2	500
CO	Tupelo	1-hr	18	283573	3947780	94.1	2001	23	20	135.2	2000
PM_{10}	Tupelo	24-hr	18	283573	3947780	94.1	2003	13	24	3.6	5
NO2	Tupelo	Annual	30	283224	3947546	103.6	2005	365	24	0.75	1

The modeling results summarized in Table 27 demonstrate that predicted impacts from the proposed facility would be less than the Class II PSD significance level for all scenarios. Additional modeling, therefore, is not necessary.

Conclusions

The modeling results presented above demonstrate that emissions from the proposed CTs at the Lagoon Creek facility site would not result in an ambient impact above any of the PSD significance levels; therefore, further ambient impact analyses are not necessary.

Furthermore, the proposed facility's impacts are shown to be below the applicable *de minimis* monitoring levels for all pollutants. Thus, a preconstruction ambient monitoring analysis is not required.

Modeling was performed to evaluate the impact of the project on air quality. The modeling results also provide a comparison of impacts relative to established air quality metrics. In particular, pollutant-specific National Ambient Air Quality Standards are the concentration level established by USEPA to protect public health. Additionally, USEPA recognizes that there are unavoidable air quality impacts associated with industrial development and has established levels for determining whether these impacts are unacceptable. These levels, called PSD increments, provide an even more stringent metric for comparing the relative air quality impacts of alternatives.

The operating scenarios evaluated are conservative for the facility under consideration. Furthermore, any specific strategies necessary for limiting emissions to meet PSD requirements for ambient air quality impacts would be defined through the PSD permitting process.

It should be noted that the above tables do not include modeling results for ozone because there is no acceptable technique for modeling the impact that emissions from a single facility might have on ozone levels. NOx emissions are associated with both ozone destruction and formation. Ozone is not emitted by the plant directly into the atmosphere but is formed due to a series of photochemical reactions that involve NOx and other chemicals. For this reason, efforts to reduce levels of ozone in the atmosphere focus on emissions reductions on a regional scale, particularly when addressing 8-hour average ozone levels. For perspective, however, a comparison of NOx emissions from the proposed facility to the NOx emissions in the region provides some information on the potential impact of the proposed plant on regional ozone levels. The proposed facility would result in an additional 176 tons of NOx being emitted each year. NOx emissions from all sources in Tennessee were approximately 612,492 tons during 2002(1). Thus, the proposed source would represent less than 0.03 percent of Tennessee's emissions. Because of the design of the CT (to use low-polluting burners) and the use of best available

NOx control equipment (i.e., SCRs) NOx emissions from the facility are expected to have no discernible impact on ozone levels.

Hazardous Air Pollutants

Title III of the 1990 Amendments to the CAA mandated a new approach to regulation of hazardous air pollutants (HAPs). The former CAA requirement that National Emission Standards for Hazardous Air Pollutants (NESHAP) protect health with an ample margin of safety has been replaced by a control-technology approach, with an evaluation of residual health risks to be performed later. The USEPA must set NESHAP to reflect the maximum achievable control technology (MACT) for categories of major HAP emission sources. MACT emission standards require the maximum degree of emission reduction that is economically achievable. The CTs being evaluated in this EA fall within one of the categories of emission sources for which USEPA will be setting MACT standards (Stationary Turbines, scheduled for November 15, 2000, but not yet published). Currently, no NESHAP has been set for this source category.

In the past, when states evaluated emission units not subject to a NESHAP, dispersion modeling of the predicted emission rates was typically performed to compare the predicted ambient concentrations with an occupational health standard or guideline such as the Threshold Limit Values (TLV). The TLVs are guidelines to be used by professional industrial hygienists. TLVs are set by the American Conference of Governmental Industrial Hygienists (ACGIH) and refer to airborne concentrations of chemical substance and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects. The Threshold Limit Value-Time Weighted Average (TLV-TWA) is the concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed for a working lifetime without adverse effects (ACGIH 2007 TLVs and Biological Exposure Indices (BEIs). These TLVs are generally adjusted downward to take into account the potential that the general populace could be continuously exposed to ambient concentrations and the potential that groups in the general populace could be more susceptible to the pollutant effects than a healthy workforce.

HAP emissions were estimated from emission factors developed from USEPA's source test database. The short-term emission rates for CTs, gas heaters, auxiliary boiler, and cooling towers are shown in Table 28, and the annual emission rates for the facility as a whole are shown in Table 29. A MACT emission standard has been established for CTs at 40 CFR 63 Subpart YYY, which limits formaldehyde emissions to 91 ppbvd at 15 percent O_2.

The USEPA regulatory model, AERMOD, was used to estimate the maximum 1-hour ambient concentration of these pollutants using the same sets of meteorological data, which were used for the modeling of the criteria pollutants. The modeling scenario that provided the worst case for the criteria pollutant modeling was used for conservatism (Scenario 14A). Maximum 1-hour estimated ambient concentration levels of each pollutant for each set of sources are shown in Table 30, along with the corresponding TLV-TWA. The maximum predicted 1-hour concentrations (based on short-term emission rates) were well below the TLVs for all of the pollutants. This indicates that the emissions of HAPs from the proposed alternatives would not cause significant adverse effects to human health in the surrounding area.

Table 28. Estimated Short-Term Emissions for Hazardous Air Pollutants

Pollutant	Emission Rate[a,b] (g/s)			
	Combustion Turbines	Natural Gas Heaters	Auxiliary Boiler	Cooling Towers
Antimony	9.85E-05	3.52E-07	1.07E-06	6.07E-07
Arsenic	1.09E-04	3.91E-07	1.19E-06	6.07E-07
Beryllium	5.64E-06	2.02E-08	6.14E-08	6.07E-07
Cadmium	2.26E-05	8.06E-08	2.46E-07	6.07E-08
Chromium	6.20E-04	2.22E-06	6.76E-06	6.07E-07
Cobalt	4.51E-05	1.61E-07	4.92E-07	ND
Lead	2.26E-04	8.06E-07	2.46E-06	6.07E-07
Manganese	2.08E-04	7.43E-07	2.26E-06	7.29E-05
Nickel	1.15E-03	4.10E-06	1.25E-05	1.21E-06
Mercury	4.51E-07 1.13	1.61E-09	4.92E-09	1.58E-05
Selenium	1.13E-05	4.03E-08	1.23E-07	6.07E-07
H_2SO_4[c]	4.38E-01	1.71E-04	5.20E-04	ND
HCl	ND	ND	ND	ND
Formaldehyde[d]	1.17E-01	1.47E-04	4.47E-04	ND
Total organic HAP	4.74E-01	4.03E-03	1.23E-02	ND

ND - No data available
a - To convert from grams per second (g/s) to pounds per hour (lb/hr), multiply by 7.94.
b - To convert from scientific notation to whole numbers, move the decimal (to the left for a negative sign or right for positive) the number of places indicated. For example, 1.08E-04 converts to 0.000108.
c - Sulfuric acid (H_2SO_4) is not a listed hazardous air pollutant under Section 112 of the CAA but is included here because it is regulated under other provisions of the CAA.
d - Based on 40 CFR 63 Subpart YYYY limit of 91 ppbvd at 15 percent O_2.

Table 29. Estimated Annual Emissions for Hazardous Air Pollutants

Pollutant	Emission Rate[a, b] (tons/year)
Antimony	3.25E-03
Arsenic	3.60E-03
Beryllium	2.06E-04
Cadmium	7.41E-04
Chromium	2.03E-02
Cobalt	1.48E-03
Lead	7.41E-03
Manganese	9.35E-03
Nickel	3.77E-02
Mercury	5.64E-04
Selenium	3.93E-04
H_2SO_4[c]	15.0
HCl	0.00
Formaldehyde	4.08
Total organic HAP	11.6

a - Emission estimates for the entire facility (total for all fuels).
b - To convert from tons per year (tons/yr) to kilograms per year (kg/yr), multiply by 907.2.
c - Sulfuric acid (H_2SO_4) is not a listed hazardous air pollutant under Section 112 of the CAA but is included here because it is regulated under other provisions of the CAA.

Table 30. Estimated Impact of Hazardous Air Pollutants

Pollutant	Community (TLV-TWA) (mg/m^3)	Highest 1-Hour Concentration[a] (mg/m3)			
		Combustion Turbines	Natural Gas Heaters	Auxiliary Boiler	Cooling Towers
Antimony	0.5	2.40E-07	1.47E-07	1.85E-07	1.43E-07
Arsenic	0.01	2.66E-07	1.63E-07	2.06E-07	1.43E-07
Beryllium	0.00005	1.38E-08	8.42E-09	1.06E-08	1.43E-07
Cadmium	0.002	5.51E-08	3.36E-08	4.26E-08	1.43E-07
Chromium	0.5	1.51E-06	9.25E-07	1.17E-06	1.43E-07
Cobalt	0.02	1.10E-07	6.71E-08	8.53E-08	1.43E-07
Lead	0.05	5.51E-09	3.36E-07	4.26E-07	0.00E+00
Manganese	0.2	5.08E-07	3.10E-07	3.92E-07	1.43E-07
Nickel	1.5	2.81E-06	1.71E-06	2.17E-06	1.72E-05
Mercury	0.025	1.10E-09	6.71E-10	8.53E-10	2.86E-07
Selenium	0.2	2.76E-08	1.68E-08	2.13E-08	3.74E-06
H_2SO_4 [b]	0.2	1.07E-03	7.13E-05	9.01E-05	1.43E-07
HCl	NA	ND	ND	ND	ND
Formaldehyde	NA	2.85E-04	6.13E-05	7.75E-05	ND
Total organic HAP	NA	1.16E-03	1.68E-03	2.13E-03	ND

ND - No data available

a - To convert from scientific notation to whole numbers, move the decimal (to the left for a negative sign or right for positive) the number of places indicated. For example, 5.64E-05 converts to 0.0000564.

b - Sulfuric acid (H_2SO_4) is not a listed hazardous air pollutant under Section 112 of the CAA but is included here because it is regulated under other provisions of the CAA.

CULTURAL RESOURCES

Affected Environment

The west Tennessee area has been an area of human occupation for the last 12,000 years. In this area, prehistoric chronology is generally broken into five broad time periods: Paleo-Indian, Archaic, Gulf Formational, Woodland, and Mississippian. Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on floodplains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. Haywood County was created in 1823-24 from parts of Madison County. Cotton supported the majority of the county's economy before and after the Civil War. In 1846, trains were introduced to Tennessee, which increased the production of staple crops. The federal Farm Security Administration established the Haywood County Farm Project in 1939-40. The Haywood County Farm Project provided small farms to black residents that they could either rent or own. Industrial development supported agricultural production. Significant industrialization came during World War II, as farmers and farm laborers left the fields, and agriculture mechanized. Haywood County has grown from a population of 265 families in 1826 to a population that now exceeds 19,000 (Nunn 1998).

The archaeological area of potential effect (APE) for the project was determined as all areas in which land-disturbing activities would take place, which include the proposed 6-acre laydown yard area and a tower site. The APE for architectural studies includes a 0.805-km (0.5-mile) area surrounding the proposed transmission line route, as well as any areas where the project would alter existing topography or vegetation in view of a historic resource. A preliminary records search was conducted prior to the survey, and no previously recorded archaeological resources and two previously recorded architectural resources (HD-440 and HD-1608) were identified within the APE. HD-440 and HD-1608 were recorded in 1999 and were considered ineligible for listing in the National Register of Historic Places (NRHP). However, HD-440 and HD-1608 are no longer extant within the APE.

The archaeological survey was conducted on June 10, 2008. The 6-acre area where the laydown yard is proposed has been previously disturbed. Part of the APE has been previously graded in connection with the construction of the adjacent power plant. The other portion is covered and compacted with gravel and serves as a parking area. No original intact ground surfaces were discovered within the 6 acres, and no archaeological material was identified. The tower site is also in an area that has been impacted by construction from the adjacent power plant. No original intact ground surfaces were discovered at the tower location, and no archaeological material was identified. The architectural survey identified no previously unrecorded architectural resources within the APE.

Environmental Consequences

No previously unrecorded archaeological or architectural resources were identified within the APE of the proposed 6-acre laydown yard and new tower site. No previously recorded archaeological resources and two previously recorded architectural resources (HD-440 and HD-1608) were identified within the proposed APE. HD-440 and HD-1608 were considered ineligible for listing in the NRHP, and they no longer exist.

Pending State Historic Preservation Officer concurrence of TVA's June 23, 2008 request where TVA determined that the proposed undertaking would not affect any historic properties that are potentially eligible or currently listed in the NRHP.

SOCIOECONOMICS

Affected Environment

The estimated population of Haywood County in 2007 was 19,126, a decrease from the 2000 Census count of 19,797 (U.S. Census Bureau 2008a). Total employment in the county was 8,897 in 2006 (Bureau of Economic Analysis 2008). The county is more dependent on farming and manufacturing employment than are the state and the nation. About 6.8 percent of jobs in Haywood County in 2006 were in farming and 24.0 percent in manufacturing. Statewide, farming was about 2.6 percent of the total and manufacturing 11.1 percent. Nationally, farming accounted for about 1.6 percent of jobs and manufacturing about 8.3 percent. Per capita personal income in Haywood County in 2006 was $24,694, about 77 percent of the state average of $32,172 and 67 percent of the national average of $36,714 (ibid).

About 54 percent of the population of Haywood County in 2000 was minority, either nonwhite or Hispanic (U.S. Census Bureau undated). This is much higher than in the state (about 21 percent) and the nation (about 31 percent). The poverty level in Haywood County in 2005 is estimated to be 19.8 percent, higher than both the state at 15.6 percent and the nation at 13.3 percent (U.S. Census Bureau 2008b).

Environmental Consequences

CONSTRUCTION IMPACTS

During construction, employment at the site would gradually increase until reaching a maximum of close to 500 workers at about the 15th and 16th months. It would then decrease until reaching completion in a total of about 25 months. At and near peak, this would be an increase of more than 5 percent in the number of jobs in the county; the increase would be almost 3 percent or greater for about one year. This would be a short-term noticeable increase in jobs. Some of these workers would already be Haywood County residents and many of the others would be residents of nearby counties, especially Shelby and Madison counties. Workers from these local areas would commute daily. Other workers would temporarily relocate to Haywood County and surrounding counties, depending on where appropriate facilities were available. It is likely that Haywood, Madison, and Shelby would be the chosen location of most of these workers, due to commuting convenience and availability of housing or facilities for mobile housing. As a result, there would be some temporary small increase in income in Haywood County and the surrounding area as workers purchase goods and services.

Due to the short duration of construction, many of the workers who move would not bring their families with them. In addition, as noted above, some who move would locate in surrounding counties. Therefore, impacts on community services, including schools, in Haywood County generally would be small during much of the construction; some impacts could be moderate during the higher employment levels, which are expected to peak around the 15th to 16th months of construction. Impacts likely would not be noticeable in surrounding counties since these counties would have few movers relative to the existing population. There would be some increase in road traffic in the area. Most of this, however, would likely be along Interstate 40 and U.S. Highway 70 until reaching the local access roads to the site. Road impacts would be most noticeable on the local roads immediately around the site.

OPERATIONAL IMPACTS

Operation of the plant would provide a small number of jobs, resulting in a small increase in total employment and income in the county. However, the employment level would be small and not an important impact to the local economy. TVA in-lieu-of-tax payments received by the county would increase as a result of the plant location in the county. These payments are discussed in TVA 2000.

GREENHOUSE GASES

Affected Environment

CLIMATE CHANGE

Climate Science

Certain substances present in the atmosphere act like the glass in a greenhouse to retain a portion of the heat that is radiated from the surface of the earth. The common term for this phenomenon is the “greenhouse effect,” and it is essential for sustaining life on earth. Water vapor and, to a lesser extent, water droplets in the atmosphere are responsible for 90 to 95 percent of the greenhouse effect. Certain gases, primarily carbon dioxide (CO_2), nitrous oxide, and methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are responsible for the rest. These gases are typically referred to as “greenhouse gases” or GHGs in the ongoing debate. Both man-made and natural processes produce GHGs. Increases in the earth’s average surface temperatures linked in part to increasing concentrations of GHGs, particularly CO_2, in the atmosphere have been a cause for concern among scientists and policymakers. On the international level, this phenomenon has been studied since 1992 by the United Nations Framework Convention on Climate Change, Intergovernmental Panel on Climate Change (IPCC).

The primary GHG emitted by electric utilities is CO_2 produced by the combustion of coal and other fossil fuels. Hydrofluorocarbon-containing refrigeration equipment is widely used by the industry but only emitted to the atmosphere in small amounts through equipment leaks. Sulfur hexafluoride (SF6), which is used as a gaseous dielectric medium for high-voltage (1 kV and above) circuit breakers, switchgears, and other electrical equipment, often replacing polychlorinated biphenyls, is also emitted in small amounts to the atmosphere.

The global carbon cycle is made up of large carbon sources and sinks. Billions of tons of carbon in the form of CO_2 are absorbed by oceans and living biomass (i.e., sinks) and are emitted to the atmosphere annually through natural processes (i.e., sources). When in equilibrium, carbon fluxes among these various reservoirs are roughly balanced. Since the Industrial Revolution (i.e., about 1750), global atmospheric concentrations of CO_2 have risen about 36 percent (IPCC 2007), principally due to the combustion of fossil fuels. Within the U.S., fuel combustion accounted for 94.2 percent of CO_2 emissions in 2006. Globally, approximately 29 billion tons of CO_2 were added to the atmosphere through the combustion of fossil fuels in 2005, of which the United States accounted for about 20 percent. Changes in land use and forestry practices can also emit CO_2 (e.g., through conversion of forestland to agricultural or urban use) or can act as a sink for CO_2 (e.g., through net additions to forest biomass) (USEPA 2008).

Environmental Consequences

CO_2 EMISSIONS

Worldwide man-made annual CO_2 emissions are estimated at 29 billion tons, with the U.S. responsible for 20 percent of these tons. U.S. electric utilities, in turn, emit 2.5 billion tons, roughly 39 percent of the U.S. total. Figure 8 shows how TVA's approximately 114 million tons of annual CO_2 emissions from energy production ranks in terms of worldwide, national, and industry emissions. The addition of the LCCC gas-fired plant operated in a projected intermediate capacity mode would increase TVA's total CO_2 by approximately 700,000 tons annually. This is less than 1 percent of TVA's total output of CO_2.

In 2007, fossil-fired generation accounted for 63 percent of TVA's total electric generation and nonemitting sources such as nuclear; hydro and renewables accounted for 37 percent. As a rule of thumb, a coal-fired plant produces about 2,000 pounds of CO_2 per MW hour of generation, and natural gas CC generation produces about 1,000 pounds of CO_2 per MW hour.

Figure 9 shows that TVA's total CO_2 emissions are expected to remain relatively steady, growing by less than 0.3 percent per year. However, TVA's CO_2 emission rate is projected to decrease by approximately 11 percent through 2012 as shown in blue on Figure 9. This is primarily as a result of returning Browns Ferry Unit 1 to service, and completing the Hydromodernization and Nuclear Uprate programs. The addition of Watts Bar Nuclear Plant (WBN) Unit 2 to the fleet would further reduce TVA's future CO_2 emission rate.

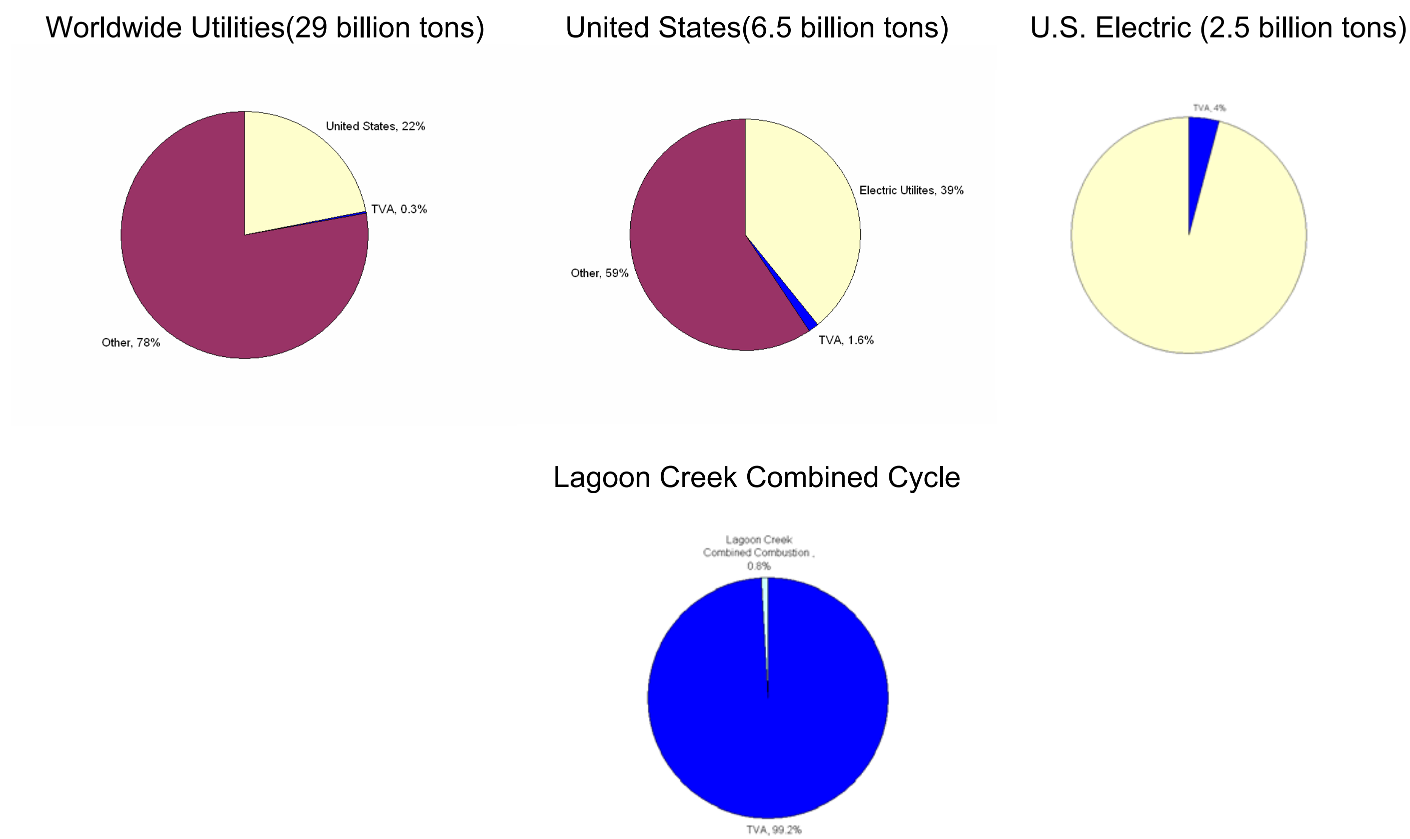


Figure 8. 2004 Man-Made Carbon Dioxide Emission Percentages

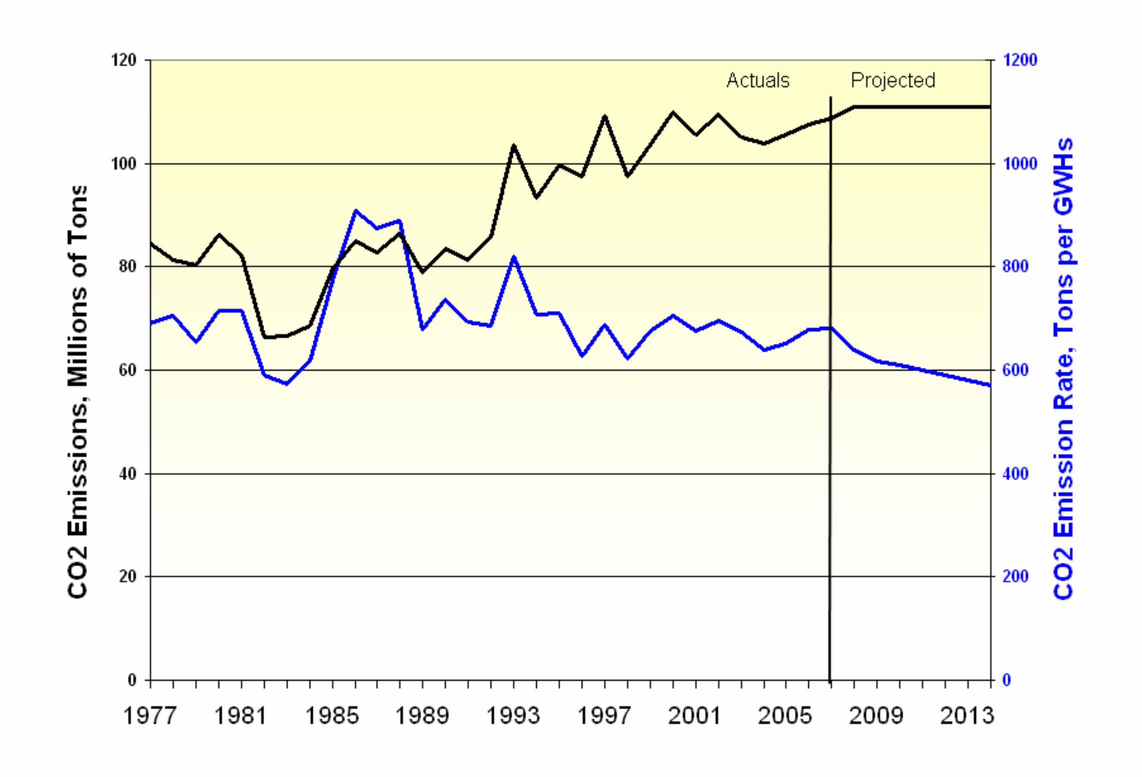


Figure 9. TVA CO_2 Emissions and Emission Rates

TVA'S REDUCTIONS AND FUTURE PLANS

TVA is participating in a number of voluntary partnerships to reduce, offset, or sequester GHG emissions and has set up a system to account for these actions. In 1995, TVA was the first utility in the nation to participate in "Climate Challenge," a Department of Energy-sponsored voluntary greenhouse gas reduction program. Over the past decade, TVA has reduced, avoided, or sequestered over 305 million tons of CO_2 under this program with the restart and operation of Browns Ferry Units 2 and 3 and startup and operation of WBN Unit 1 accounting for most of the tons reported, along with the Hydromodernization Program and the Buffalo Mountain Wind Farm. TVA is participating in the President's Climate VISION Program, which calls on the electric utility sector, along with other industry sectors, to help meet a national goal of reducing the greenhouse gas intensity of the U.S. economy by 18 percent from 2002 to 2012.

TVA's May 2008 Environmental Policy includes a strategic objective that addresses climate change mitigation. TVA's Climate Strategy Plan would stop the growth in volume of emissions and reduce the carbon emission rate by 2020 by: (1) reducing load growth by at least one-fourth over five years through energy efficiency and demand-side management; (2) meeting remaining load growth through lower carbon-emitting sources such as renewables, nuclear, and combined heat and power; (3) improving the efficiency of the transmission network; (4) striving to reduce the GHG emission rate of the existing fleet; (5) using affordable resources to comply with renewable and clean energy requirements and limiting the use of purchased compliance credits; (6) investing in a technology portfolio that supports low/zero carbon-emitting generation options and grid infrastructure; (7) promoting education/outreach to encourage energy efficiency and other options;

(8) continuing to monitor legislative and regulatory developments to assess any potential financial impacts as information becomes available.

TVA is also investigating technologies of the future. These include:

- Integrated Gasification/Combined Cycle
- Participating in the Coal Fleet of the Future Project
- Supporting additional research on the issue of global climate change via participation in the Electric Power Research Institute

UNCERTAINTY

The current scientific knowledge of climate change is improving but still contains a great amount of uncertainty. Confidence that there would be global warming is high; whereas, confidence in regional descriptions of future climate changes is low because:

- Continued emissions of greenhouse gases would inevitably produce climate change, but at what point, and for whom, the climate change is considered dangerous is unknown.
- The prospect of climate change implies concrete action in the short term to lessen unclear damage decades hence.
- The tools associated with assessing potential climate change are imperfect, but insights available from past changes are also limited because the present situation (especially given the involvement of humans) is unique (Mitchell 1977).

CUMULATIVE IMPACTS

The cumulative drawdowns predicted in the Memphis aquifer at the end of the simulation period due to groundwater withdrawals by all major public and industrial users in the region (including TVA CT plants) are presented in Figures 3 and 4. Extensive groundwater withdrawals in Shelby County, Tennessee, account for much of the cumulative drawdown predicted in the Memphis aquifer in the site region, despite the distance separating the plant from Shelby County (Figure 3). For example, total groundwater pumpage reported in Shelby County in 2000 averaged 188 MGD, accounting for approximately 72 percent of total groundwater usage in western Tennessee (Webbers 2003). Other major pumping centers in closer proximity to the plant site include public groundwater systems operated by Brownsville, Dyersburg, Ripley, Covington, and Trenton.

Cumulative drawdown predicted in the plant locality (Figure 4) is substantially greater than that produced by LCCC plant groundwater use alone (Figure 2). Cumulative drawdowns range from approximately 24 feet at the plant boundary to about 11 feet at Brownsville. Regional groundwater withdrawals by all non-TVA users account for about 10 to 14 feet of drawdown in the plant locality. Moderate drawdowns of less than 20 feet would be expected in the Memphis aquifer wells located closest to the LCCC plant. Drawdowns of this magnitude would result in minor increases in pumping lifts and associated costs but would not be expected to impair well performance. Predicted cumulative drawdowns of approximately 10 feet or less were predicted in both Cockfield and Fort Pillow aquifers, which again would not be expected to impair performance of existing wells completed in these aquifers.

SUMMARY OF ENVIRONMENTAL COMMITMENTS

- Compressor wash water would be collected and disposed off site at an approved wastewater treatment facility.

- A biocide may be dosed to the cooling towers intermittently to control biological slimes in the cooling towers. If and when a biocide is added to the cooling towers, cooling tower blowdown would be halted for approximately four hours both to provide maximum effectiveness for the biocide and to prevent discharge of any significant amount of biocide.

- If the iron is not being adequately removed to NPDES narrative permit requirements in the process pond, additional treatment, such as baffles to increase retention time, or coagulation with polymers, or filtration, would be added to ensure the final effluent met all applicable permit limitations.

- If the WET testing reveals any potential impacts to Lagoon Creek, TVA would use an adaptive-management approach to determine the source of the toxicity, and address the source with appropriate process modifications or wastewater treatment alternatives.

PREFERRED ALTERNATIVE

TVA preferred alternative is to construct a new, highly efficient gas-fired CC CT plant adjacent to its Lagoon Creek CT facility near Brownsville, Tennessee, to meet future power demands. The new units would burn natural gas. If constructed, total capacity under standard conditions would be approximately 600 MW. These units would be permitted to operate in intermediate- to base-load mode; however, TVA's current projections indicate that the units would operate more toward the intermediate-load capacity.

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ATTACHMENTS

1. American Ground Water Trust publication: *The ABC of Aquifers*
2. List of Acronyms, Abbreviations, and Terms

ATTACHMENT 1

THE ABC OF AQUIFERS

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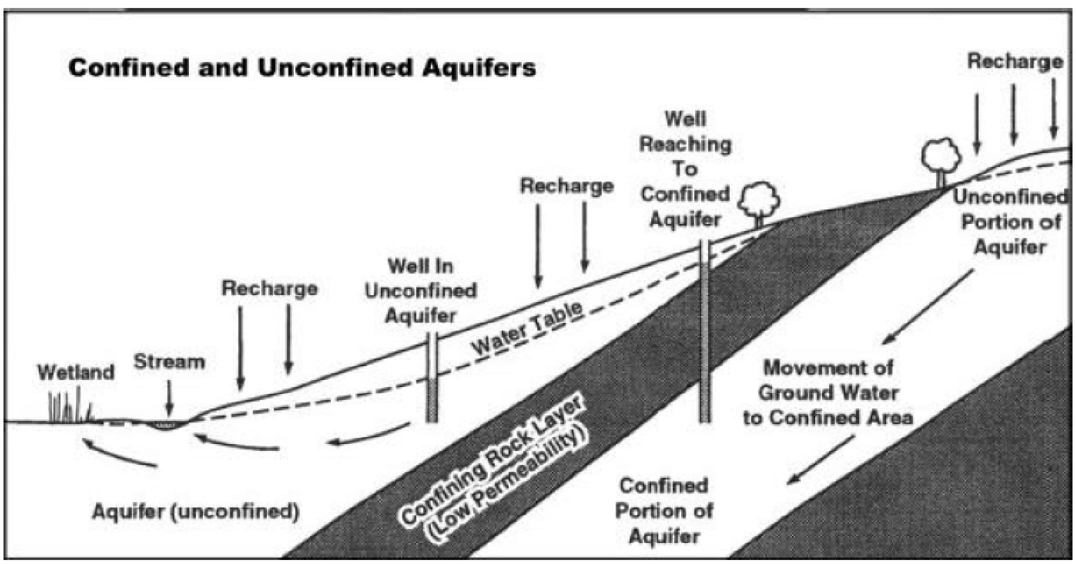
When you are "talking ground water" it won't be long before you will be asked to explain the word aquifer. This article covers the basics about aquifers. There are many variations of geology and hydrology that may make an aquifer. Some aquifers extend over long distances and to great depths. Many aquifers are small and localized. Aquifers contain ground water but not all sub-surface water is in aquifers! Geologic cross section figures are very useful when explaining ground water.

The word aquifer comes from the Latin words, "Aqua" (water), and "fer" (to carry). An aquifer is often described as a sub-surface geologic formation(s) (solid rock and/or unconsolidated sediments) that contains ground water in sufficient quantities to be used, or have the potential to be used, for drinking water supply or for commercial, industrial or agricultural purposes. Ground water is nearly always found when a well is drilled, although in some places there may be a very low rate of flow to the well. How large does a well's yield have to be to qualify a saturated rock as an aquifer? Half a gallon a minute will provide 700 gallons a day, but many people would not describe such low yielding rock formations as aquifers. So, by some definitions many low yielding domestic wells are not really in aquifers. All water wells pump ground water but they don't all pump from aquifers!

In general, there are three main categories of aquifers: unconfined, confined and perched. In reality, there can be a number of combinations and variations.

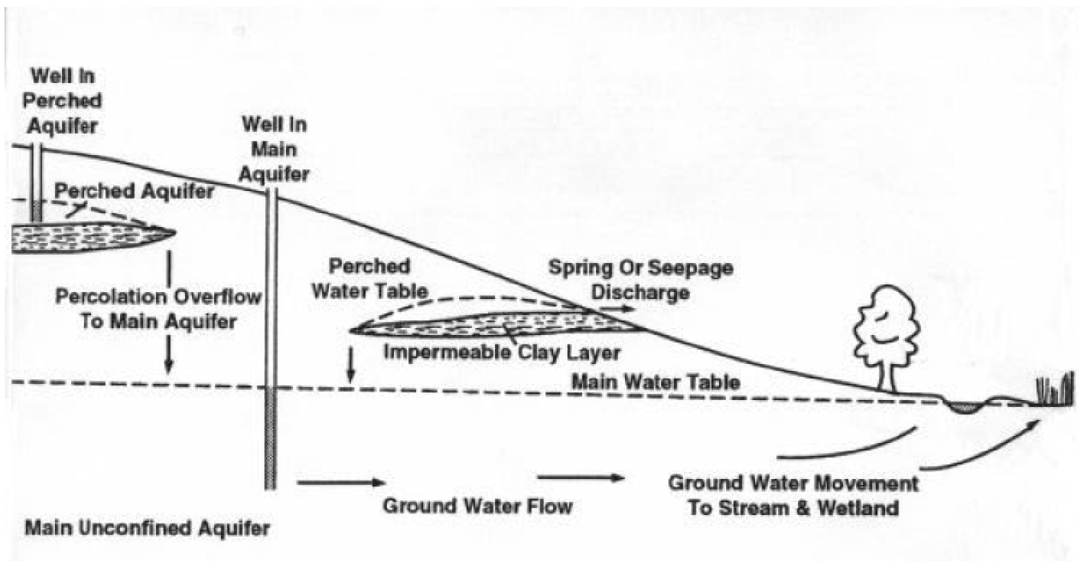


UNCONFINED AQUIFERS are covered by permeable geologic formations (either solid rock or unconsolidated sediments) and the upper surface where the rock formations are fully saturated is called the water table. These aquifers are also known as water table aquifers. They receive recharge directly from the infiltration of rainfall and surface water.

CONFINED AQUIFERS are those that are covered (confined) by an impermeable or semi-permeable layer of rock. Confined aquifers are not directly recharged by vertical infiltration. Confined aquifers need to be connected to an unconfined area through which recharge can occur. The confining impermeable layers rarely form a complete barrier to ground water. There is generally some transfer or flow of ground water between the confined aquifer and the confining layers.

In confined and unconfined aquifers there may be considerable amounts of ground water that are stored in impermeable/semi-permeable sediments such as clays. Water from these sediments can reach a well if they are in contact with permeable layers that are intersected by the well. So although clays are not thought usually thought of as aquifers they may be a key part of the storage in an aquifer system. When aquifers are polluted, it is almost impossible to flush out contaminants from fine-grained clay layers where much of the aquifer's water may be stored.

Artesian aquifer is the name sometimes used to describe confined aquifers. In confined aquifers, ground water is under pressure. The water level in a confined aquifer well may be close to the surface, perhaps many 10's or even 100's of feet above the aquifer. An overflowing artesian well occurs where the water pressure in the aquifer is sufficient to raise water levels to cause natural flow at the surface. The term artesian is often used incorrectly to describe any well drilled into solid rock. Water levels in most aquifers vary with the season and during droughts. It is a debatable point whether an "empty" aquifer is still an aquifer and there is no scientific agreement about what to call the permanently depleted portions of over-drafted aquifers. For purposes of wise ground water protection policy, we should consider as aquifers, the full vertical and horizontal extent of seasonally dewatered or over-pumped rock formations.



PERCHED AQUIFERS occur where ground water is perched above unsaturated rock formations as a result of a discontinuous impermeable layer. Perched aquifers are fairly common in glacial sediments. They also occur in other sedimentary formations where weathered layers, ancient soils or caliche (a calcareous layer common in semi-arid areas) have created impermeable zones.

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ATTACHMENT 2

ACRONYMS, ABBREVIATIONS, AND TERMS

μg/L	Microgram per Liter
$\mu g/m^3$	Microgram per Cubic Meter
3Q20	The minimum 3-day flow that occurs once in 20 years
ACGIH	American Conference of Governmental Industrial Hygienists
APE	Area of Potential Effect
BACT	Best Available Control Technology
BEI	Biological Exposure Indices
BMP(s)	Best Management Practice(s)
CAA	Clean Air Act
CaCO3	Calcium Carbonate
Ca/Mg	Calcium/Magnesium
CC	Combined Cycle
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CT(s)	Combustion Turbine(s)
dB	Decibel
dBA	Decibel, A-weighted
dBC	Decibel, C-weighted
DCS	Disturbance Control Standard
EA	Environmental Assessment
GHG	Greenhouse Gas
gpd	Gallons per Day
gpm	Gallons per Minute
g/s	Grams per Second
H_2SO_4	Sulfuric Acid
HAP(s)	Hazardous Air Pollutant(s)
HRSG	Heat Recovery Steam Generator
HUC	Hydrologic Unit Code
Ibid	Abbreviation for the Latin term, *ibidem*, meaning “in the same place”; refers to the immediately preceding work cited
IPCC	Intergovernmental Panel on Climate Change
K	Kelvin
kg/yr	Kilograms per Year
km	Kilometers
kV	Kilovolt
Lbs/Hr	Pounds per Hour
LCCC	Lagoon Creek Combined Cycle
Ldn	Day-Night Average Sound Level
Leq	Average A-weighted sound level
m	Meter
MACT	Maximum Achievable Control Technology
MCL	Maximum Contaminant Level

MERAS	Mississippi Embayment Regional Aquifer Study
MGD	Millions of Gallons per Day
mg/L	Milligrams per Liter
mg/m^3	Milligrams per Cubic Meter
m/s	Milligrams per Second
msl	Mean Sea Level
MW	Megawatt
NERC	North American Electric Reliability Council
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
NRHP	National Register of Historic Places
NSR	New Source Review
NTU	Nephelometric Turbidity Unit
NWS	National Weather Service
PC Units	Platinum Cobalt Units
PM	Particulate Matter
ppbvd	Part per billion dry basis
ppm	Parts per Million
PSD	Prevention of Significant Deterioration
SC	Simple Cycle
SCR	Selective Catalytic Reduction
s.u.	Standard Units
TDEC	Tennessee Department of Environment and Conservation
TLV	Threshold Limit Values
TVA	Tennessee Valley Authority
TWA	Time Weighted Average
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WBN	Watts Bar Nuclear Plant
WET	Whole Effluent Toxicity